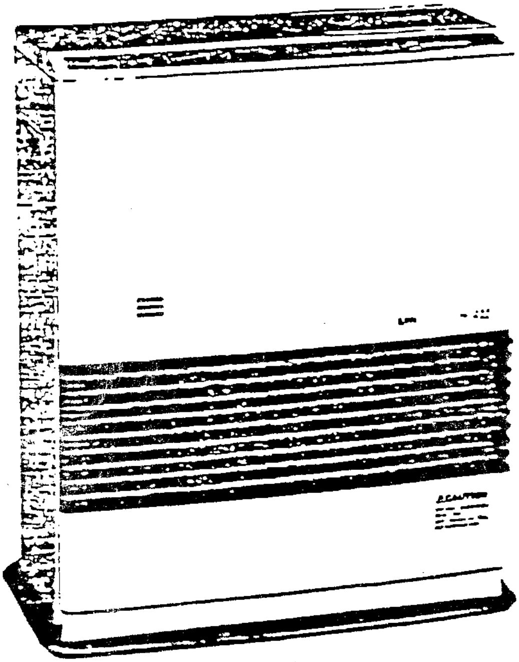
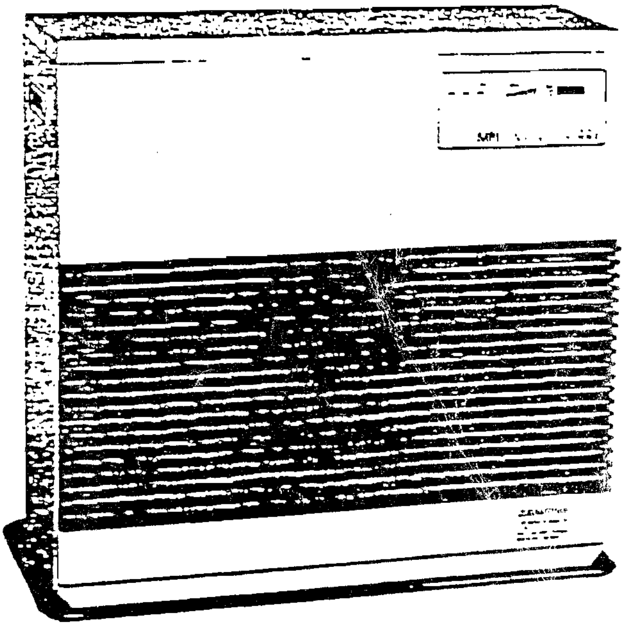
MONITOR HEATING SYSTEMS

Service Manual



MONITOR 422
MONITOR 22
MONITOR 21



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Monitor 422 Printed Circuit Board Wiring Diagram

1-1 SPECIFICATIONS

Model	Monitor 441	Monitor 422
Fuel Type	Crystal Clear K-1 Kerosene	Crystal Clear K-1 Kerosene
Heater Efficiency	93%*	93%*
Heat Rating	High:43,000 BTU/hour H.Medium:33,900 BTU/hour L.Medium:21,000 BTU/hour Low:16,200 BTU/hour	High:22,000 BTU/hour H.Medium:17,400 BTU/hour L.Medium:11,700 BTU/hour Low:9,600 BTU/hour
Heater Output	High:40,000 BTU/hour H.Medium: 31,500 BTU/hour L.Medium: 19,500 BTU/hour Low: 15,000 BTU/hour	High:20,400 BTU/hour H.Medium: 16,200 BTU/hour L.Medium: 10,900 BTU/hour Low: 8,900 BTU/hour
Fuel Tank	Separate(Not supplied with heater)	1.32 Gallons; Separate tank optional
Fuel Consumption	High: 0.319 Gallon/hour H.Medium: 0.25 Gallon/hour L.Medium: 0.16 Gallon/hour Low: 0.12 Gallon/hour	High: 0.164 Gallon/hour H.Medium: 0.13 Gallon/hour L.Medium: 0.09 Gallon/hour Low: 0.07 Gallon/hour
Power Source	120 Volts AC; 60 Hz.	120 Volts AC; 60 Hz.
Power Consumption	Ignition: 340 Watts Operation: 80 Watts (Average)	Ignition: 250 Watts Operation: 55 Watts (Average)
Heated Air Delivery	High: 388 Cubic feet/minute H.Medium: 388 Cubic feet/minute L.Medium: 300 Cubic feet/minute Low: 300 Cubic feet/minute	High: 176 Cubic feet/minute H.Medium: 176 Cubic feet/minute L.Medium: 113 Cubic feet/minute Low: 113 Cubic feet/minute
Vent Pipe Hole	2½-inches Diameter	2½-inches Diameter
Dimensions	Height: 26.6 inches Width: 28.7 inches Depth: 13.8 inches	Height: 25.6 inches Width: 20.9 inches Depth: 12.4 inches
Weight	82 Pounds, empty	55 Pounds, empty

* When considering heat of condensation is lost then net efficiency is 87%.

1-2 SPECIAL FEATURES

AUTOMATIC IGNITION

Memory Back Up: Set memory can be kept in case of power failure for up to 5 minutes.

Dual Blowers: Separate fans for combustion and room air circulation.

Thermostatically Controlled: Adjusts to the desired room temperature.

Built-In Timer: Heater will automatically operate as programmed by the user.

Automatic Reset After Power Failure: Heater will automatically resume operation after power is restored.

Indicator Lights: Easy-to-see signals show-when heater is in operation, when timer is activated, and when the burner is operating in low, medium or high modes.

Choice of Fuel Supply: Large tank gravity fed system, large tank system with pump.(M-441) Built-in capsule tank or connect to separate tank. (M-422)

Multiple Heat Exchanger: Extracts 87% of heat from burner.

Clean Operation: Products of combustion are vented outside.

Consumes No Room Air: Air for combustion is drawn from outside.

Easy Installation: Complete instructions included in this guide.

1-3 SAFETY FEATURES

SAFE RE-LIGHTING: Heater will not restart until its combustion chamber has cooled.

ELECTRICAL PROTECTION: Heater automatically shuts off in the unlikely event of a malfunction in the electrical circuitry or disruption of the power supply.

NO EXHAUST IN ROOM: Products of combustion are discharged outdoors.

FLUE PIPE: Outside air is drawn through a pipe-within-a-pipe venting system. This process preheats combustion air and regains heat from exhaust gases.

1-4 DESCRIPTION

The Monitor heaters are composed of the following:

a spill tray, a cabinet, a combustion system, an air circulation system, a fuel delivery system, electrical and electronics systems and a variety of safety mechanisms.

1-5 SPILL TRAY

The Spill Tray:

- Protects the floor from damage resulting from fuel spillage.
- Provides a secure, tip-resistant heater base.

Metal retainers (2) secure the heater to the Spill Tray.

The legs are positioned with in the circular indentations.

1-6 HEATER CABINET

A steel Cabinet holds and protects all internal components.

A number of primary parts are assembled to form this housing.

1-7 COMBUSTION SYSTEM

The Combustion System is responsible for the production of heat which is circulated into the room.

In the Combustion Systems a mixture of fuel and air is burned to produce heat. Air is drawn from outside the dwelling into the Combustion Chamber. At the same time, fuel is metered from a storage cavity into this same Combustion Chamber.Within the chamber,the air/fuel mixture is ignited to produce heat. The Monitor combustion systems are safeguarded by a pair of overheat protector switches; They will shut down the heater (to protect it from damage) in the event of excessive heat build-up. The overheat protector switches reset automatically after cooling down.

1-8 COMBUSTION CHAMBER

This tall cylinder is positioned on the Heater Base. It is secured to the base by phillips head screws.

Connected to the Combustion Chamber are the igniter, (located within the chamber) a fuel line, the Heat Exchanger, and a Flame Sensor.

Within the Combustion Chamber are the Burner Pot, the Combustion Ring Assembly and the Burner Cap(M-422). Access to those internally-located parts is facilitated by a removable Service panel. A Window on the panel lets the technician visually examine the combustion process(i.e. glowing igniter or proper flame color).

An airway, in the Cabinet Base, extends from the intake fan of the Combustion Blower to the hollow base of the Combustion Chamber. This airway channels air to the Combustion Chamber.

The Flame Sensor is mounted with two (2) phillips head screws onto the wall of the Combustion Chamber.

1-9 BURNER POT

Designed specifically to support combustion, the Burner Pot (refer to Figure 1-2) contains a series of air holes, an igniter tube (to accommodate the Igniter), and a fuel inlet fitting (interconnects the fuel line). It is secured to a mounting plate near the bottom of the Combustion Chamber.

The Combustion Ring Assembly is seated on three (3) screws or pins in the Burner Pot.

1-10 COMBUSTION RING ASSEMBLY

This assembly is a special structure, designed to promote efficient combustion.

1-11 BURNER CAP

Secured by tabs and a screw on the Burner Pot, the Burner Cap "shapes" the flame into its configuration and height. (M-422 only)

1-12 FLAME SENSOR

Mounted on the outside wall of Combustion Chamber, the Flame Sensor always supervises the flame.

1-13 IGNITER

Located within the igniter tube of the Burner Pot, the Igniter is designed to pre-heat the Burner Pot and to vaporize and ignite the air/fuel mixture to start the combustion process.

The Igniter is secured by a bracket and screw to the igniter tube. The cover plate is secured to the combustion chamber by three (3) phillips head screws.

1-14 COMBUSTION AIR SYSTEM

The Combustion Air System channels air to and from the heater.

Outside air is drawn into the heater by the Combustion Blower through an airway to the Combustion Chamber.

A Combustion Blower draws the intake air into the through a Flue Pipe. This air enters the Combustion Chamber at the Burner Pot and mixes with the fuel to support combustion, Remaining air is heated and is drawn into the Heat Exchanger.

As the heated air passes through the Heat Exchanger, an Air Circulation Fan blows room air past the Heat Exchanger and out again into the room, heating passing air by convection. Exhaust vapors exiting from the Hear Exchanger are vented through the Flue Pipe.

A deterioration of air pressure at the Air Pressure Switch is an abnormal condition; the heater is shut down by the malfunction.

Pot is cut off,the flame extinguishes (after all fuel currently in the line has been consumed), and the Burner Status Indicators blink.

This safety mechanism can be triggered by several conditions:

- Leak or loose connection in air line
- Leak, loose, or broken tubing which connects the Air Pressure Switch with the Combustion Blower
- Clogged or blocked Air Line
- Blocked or clogged Flue Pipe
- Intake port of Combustion Blower is blocked.
- Combustion Blower is inoperable

1-20 FUEL DELIVERY SYSTEM

Fuel Delivery is a very important aspect of the Monitor's operation.

The fuel flow must be maintained at a level corresponding to the burn mode, so that combustion can be conducted efficiently.

Fuel moves by gravity-flow from the external fuel storage tank or the capsule fuel tank to the Fuel Constant Level Valve.

The Solenoid Pump meters the flow of fuel from the Fuel Constant Level Valve to the Burner Pot.

The metered flow of fuel is carried to the Burner Pot by a copper fuel line.

1-21 EXTERNAL FUEL TANK

The Monitor 422 gives the user the option of either using the internal capsule tank or hooking up to an external fuel tank.

Fuel for the Monitors can be stored in, and fed from an external storage tank. The tank, which generally is dealer installed, should contain a shutoff valve, a fuel filter and a vent. Installation of the tank should conform to local regulations and to the specifications and guidelines documented in this Service Manual.
(Capsule tank cannot be used in Connecticut and Massachusetts.)

1-22 FUSIBLE LINK VALVE

Basically, the Fusible Link Valve is a safety mechanism that cuts-off fuel to the heater in the event of an overheat condition at the valve.

The fusible link valve is mounted as a standard item on the Monitor 422. Located outside the rear of the Heater Cabinet, the Fusible Link Valve is a spring-loaded device that cuts off the supply of fuel to the heater when the temperature level (at the valve) exceeds a predefined maximum limit.

An inlet on the bottom of the valve allows fuel to pass into the heater. The handle-which can also manually be opened or closed-sits on a spring-loaded stem which contains a low-melting point alloy.

The fusible link valve can be externally mounted on the Monitor 441 if required.

1-23 FUEL CONSTANT LEVEL VALVE

This valve has an automatic shutoff safety mechanism and a Fuel Set Lever. The safety mechanism prevents fuel from flooding or overflowing from the fuel reservoir. The Fuel Set Lever resets the float so the Fuel Constant Level Valve can resume operation.

The fuel reservoir is a tank which contains a float assembly, a safety mechanism, and a priming lever.

Both the Monitor 441 and 422 fuel control valves are basically the same, however they are of different size and material and can not be interchanged.
Fuel enters the Fuel Constant Level Valve through an inlet at the bottom of the reservoir. As the level of fuel rises, it passes through a filter (which removes most particles and foreign matter from the fuel), flows up through an open inlet valve and enters the tank.

IMPORTANT: **The Fuel Constant Level Valve filter should be cleaned or replaced periodically. Time intervals will depend on purity and quality of fuel.**

Within the Valve, a float mechanism controls the level of fuel that will be permitted to the reservoir. As the fuel level drops, the float drops down to increase the inlet valve opening to admit more fuel into the valve. When the fuel level reaches its maximum volume. the float rises to shut the inlet valve.
In the event that fuel within the reservoir rises to an abnormally high level, a float within the reservoir rises to trip a safety lever. This safety lever drops to prevent fuel from entering into the reservoir.

Should a foreign substance cause the inlet valve to stick (or prevent it from opening), the Fuel Set Lever is utilized to free the valve and to admit fuel to the reservoir.

CAUTION: **Care must be taken to prevent dust, dirt, or other debris from clogging or blocking the inlet valve. If debris collects on the seat of the inlet valve it may cause tripping of the safety lever and will require cleaning.**

1-24 SOLENOID PUMP

The Solenoid Pump is mounted on the Fuel Constant Level Valve, controlled by a microcessor,and four modes (High, Medium-High, Medium-Low, Low) fuel flow is delivered to the Burner Pot.

1-25 ELECTRICAL SYSTEM

Electrical power is supplied to the Monitor to run the Microprocessor and the other electrically-energized component.

Electrical operation of the Monitor can be thought of as having the following eight(8) distinct phases:plug in; turn-on; pre-purge/pre-heat; ignition; precombustion; heating; Shutdown and post-purge.

All electronic diagrams, Such as wiring diagram, circuit board layout, and electrical schematic can be found in Section 7 of this Service Manual.

1-26 MICROPROCESSOR

Principally consisting of a 64-pin Integrated Circuit, the Microprocessor provides safety timings, controls relays and provides clock and thermostat functions for the Monitor heater. A component layout of the Printed Circuit Board is found in Section 7 of this Service Manual.

1-27 TEMPERATURE SENSOR

The sensor which is capable of sensing room temperature within a range of 42°F to 96°F, can be left mounted on the back of the heater cabinet or be wall mounted.

Approximately $6^1/_2$' (about 200 cm) of No. 20 AWG Wire is supplied with the sensor to facilitate wall mounting the sensor in a favorable location.

1-28 SAFETY MECHANISMS

Several safety mechanisms have been built into the Monitor Heating System. These devices protect the user against personal injury, protect the heater against damage, and shutdown the heater if a malfunction occurs.

1-29 CLOTH COVERED EXHAUST PIPE

Insulating cloth covers are to be placed over all metal surfaces of the Exhaust Line during installation.

Since combustion by-products are vented at elevated temperatures, the Exhaust Pipe will become hot during operation. The insulating cloth covers protect the user from burn hazards associated with accidental contact with these heated metal surfaces.

During installation make sure that all Exhaust Lines are tight. Do not operate the heater without the insulating covers.

1-30 AIR CIRCULATION FAN GUARD

This guard is an integral part of the fan assembly.

The guard protects the user against physical injury which could occur from accidental contact with revolving metal fan blade.

1-31 FUSE

2-amp. and 10-amp., 125VAC, fuses protect the heater from damage resulting from power overloads.

In the event of a power surge or internal wiring hazards, the fuse opens and power to the heater is cut off.

The electrical outlet into which the heater is connected should be protected by at least a 15-amp. fuse or circuit breaker.

1-32 OVERHEAT PROTECTOR SWITCHES

Connected in series, two (2) normally-closed Overheat Protector Switches safeguard the heaters against damage due to overheating.

The Monitor 422 switches are rated 110°C (230°F). The Monitor 441 switches are rated 115°C (239°F). Should a Monitor overheat (internal temperatures rise beyond 110°C (230°F) on the Monitor 422, 115°C (239°F) on the Monitor 441) either or both switches will open to shut down the heater. After extinguishing the flame, the Burner Status indicators continue to blink. The Overheat Protector Switches will automatically reset after cooling down.

Once the heater has cooled to 90°C (194°F), the system can be restarted. To restart the Monitor, proceed as follows:

A. Press ON/OFF Switch to OFF.
B. Allow heater to cool.
C. Troubleshoot the cause of the overheat.
D. Press ON/OFF switch to ON
E. Proceed with normal operation.

1-33 SLIDE SELECTOR FOR THE RESET TEMP.

Once power is restored after power interruption by power failure or by disconnecting heater plug from wall outlet, heater will resume operation in the MANUAL mode and maintain room temperature according to the setting temperature selected by using the selector for the reset temperature at the lower right hand side of the cabinet.

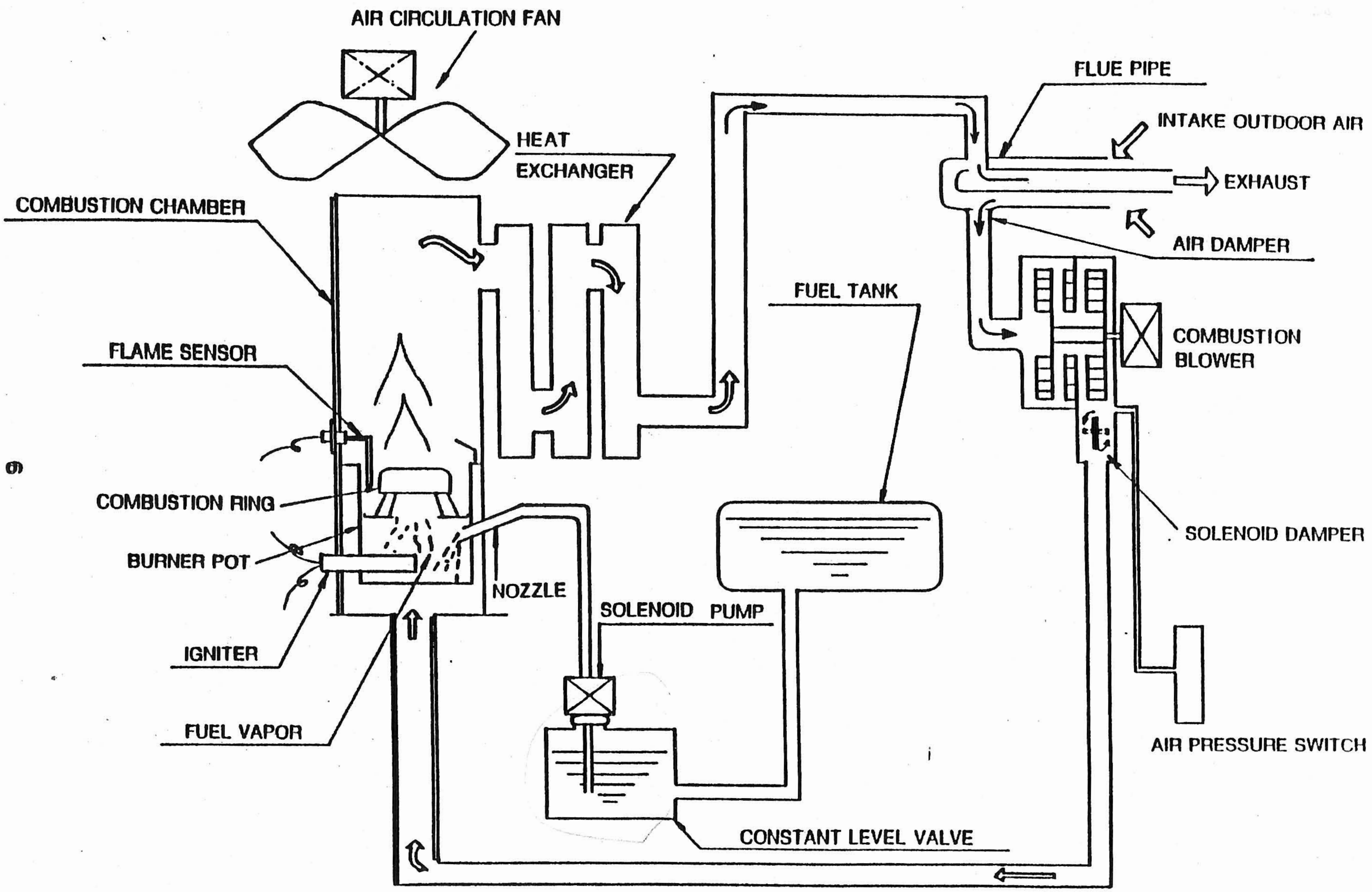

AIR CIRCULATION FAN
HEAT EXCHANGER
FLUE PIPE
INTAKE OUTDOOR AIR
EXHAUST
AIR DAMPER
COMBUSTION CHAMBER
FUEL TANK
COMBUSTION BLOWER
FLAME SENSOR
COMBUSTION RING
BURNER POT
NOZZLE
SOLENOID DAMPER
SOLENOID PUMP
IGNITER
FUEL VAPOR
AIR PRESSURE SWITCH
CONSTANT LEVEL VALVE

Figure 1-1 ELEMENTS OF COMBUSTION SYSTEM (MONITOR 441)

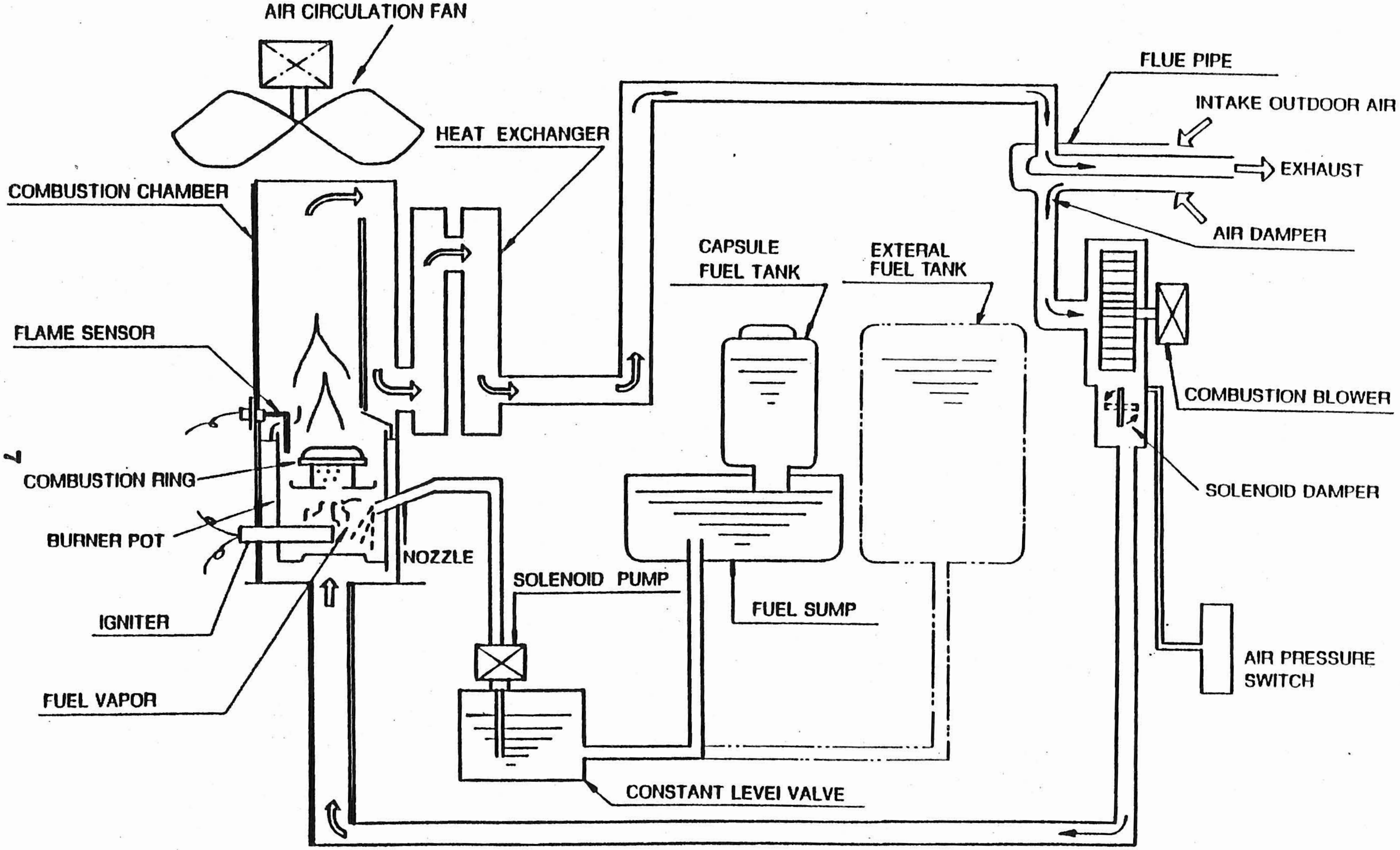

AIR CIRCULATION FAN
FLUE PIPE
INTAKE OUTDOOR AIR
HEAT EXCHANGER
EXHAUST
COMBUSTION CHAMBER
AIR DAMPER
CAPSULE FUEL TANK
EXTERAL FUEL TANK
FLAME SENSOR
COMBUSTION BLOWER
COMBUSTION RING
SOLENOID DAMPER
BURNER POT
NOZZLE
SOLENOID PUMP
FUEL SUMP
IGNITER
AIR PRESSURE SWITCH
FUEL VAPOR
CONSTANT LEVEI VALVE

Figure 1-2 ELEMENTS OF COMBUSTION SYSTEM (MONITOR 422).

NOTE: Capsule tank cannot be used in Connecticut and Massachusetts.

2-1 INTRODUCTION

Installing the Monitor System at the user's location can be performed quickly and economically. The Monitor 422 can be used as either an internally fueled (capsule tank) or remotely fueled System. The Monitor 441 model is strictly a remotely fueled system and both are externally vented. As such both need the installation of an externally vented intake/exhaust system and if remotely fueled, will need the installation of a remote fuel storage tank.

By completing each step of the easy-to-follow installation instructions (each step should be completed in the exact order specified). the Technician is directed through the installation process.

This section contains all relevant installation information including:

— Installation specifications
— List of installation tools
— Alternative types of venting systems (and installation procedures for each)
— Basic requirements for fuel tank installation
— Instructions to install the Monitor System

IMPORTANT: Before beginning installation of the Monitor vented heating system (including any electrical wiring and fuel supply equipment), check local building,electrical, mechanical and fire codes. The requirements of these codes must be followed to insure lawful installation and use.

The heater can be located almost anywhere within the dwelling provided that electrical, fuel, and exhaust specifications are met.

2-2 PHYSICAL PLACEMENT OF HEATER

In addition to the space taken up by the heater, interior space must also be reserved for free air circulation. Remove all combustibles from the heating area.

Unless building or fire codes dictate otherwise, the Monitor system can be placed on any floor surface (including carpeting or other combustible material) and provide safe operation.

2-3 DRILLING REQUIREMENTS

Through-the-wall Flue Pipe installation requires that a 2 $^{1}/_{2}$" (65mm) hole be drilled through the dwelling wall (interior to exterior). The hole must be pitched downward toward the outside at an approximate angle of 2°(about $^{1}/_{2}$" per foot). The appropriate wall area (in which hole will be drilled) must contain no internal obstacles such as piping, wiring, air ducts, or studs.

RECOMMENDED TOOL KIT FOR MONITOR HEATER SERVICE TECHNICIANS

1) #2 Phillips Head Screwdriver
2) Steel Tape Measure
3) Felt Tip Pen or Pencil
4) Caulking Material (exterior grade)
5) Electrical Drill
   (reverse capability recommended)
6) Hole Saw, Saber (Jig) Saw, or other appropriate tool for cutting a 2.5" diameter hole for flue pipe
7) Rubber Clipping Tool
8) Long Drill Bit—$^{1}/_{2}$"
9) #2 Standard Screwdriver
10) Adjustable Wrenches (various sizes)
11) Copper Tubing Cutter
12) Copper Tubing Flaring Tool
13) V.O.M.(Volt, OHM. Meter with shielded probes)
14) Level
15) Plumber's Pipe Thread Tape
16) Small assortment of Self-Tappeng Screws
17) Assorted Pliers (Slip Joint, Needlenose, Cutting, Lock Joint)
18) Phenolic Probe or Insulated Screwdriver
19) Supply of 125V, 2 and 10 Amp fuses
20) Floor mat to cover carpeting
21) Quart size pan for draining fuel

2-4 POWER REQUIREMENTS

WARNING

THE MONITOR POWER CORD MUST BE PLUGGED INTO A DIRECTLY ACCESSIBLE WALL OUTLET. DO NOT USE AN EXTENSION CORD TO MAKE THIS ELECTRICAL CONNECTION.

Line current to the system should be 120 VAC at 60 Hz. The electrical system should be protected against current overload by means of at least a 15-ampere fuse or circuit breaker.

NOTE: The wall outlet should supply electricity for the Monitor system only. Do not connect any other electrical appliance to it.

CAUTION: In some installations, it may be best to hard-wire the heater to the house circuits. A competent, licensed electrician should do this.

2-5 FUEL TANK REQUIREMENTS

WARNING:

INSTALLATION OF ANY REMOTELY LOCATED FUEL TANKS MUST COMPLY WITH ALL LOCAL STANDARDS AND/OR BUILDING CODES.

Heater fuel (crystal clear kerosene only) can be stored in remotely located storage tanks ranging from 55 gallon drums to 275 gallon tanks. When using large tanks a pressure regulator with a max. of 2.5 PSI should be installed near heater inlet.

> **CAUTION:** **In some installations, it may be better to install permanent fuel tank plumbing. A licensed Plumber should do this.**

2-6 TEMPERATURE SENSOR WIRING REQUIREMENTS

A wall-mounted temperature Sensor gauges room temperature and automatically regulates the heating cycles of the Monitor System.

The standard sensor wire is $6^{3}/_{4}$' long and can be left mounted on the back of the cabinet as shipped. If this is not practical the sensor can be mounted on a wall.

> **CAUTION:** **If sensor is to be mounted remotely be careful not to place it in direct sunlight, on uninsulated exterior walls in drafty areas etc., as this will create an inaccurate temperature reading.**

2-7 BUILDING CODES

Fire regulations, electrical and other local building codes may govern the installation and use of a vented heater and related fueling systems. Prior to installation, check and comply with all codes.

2-8 UNPACKING

Save all shipping materials until the Monitor has been completely installed and is working properly.

A. Cut the two plastic ribbons that hold the shipping carton together.
B. Remove the top.
C. Remove from the shipping carton the Cardboard (drilling) Template and the Owner's Guide.

NOTE: The Dealer should complete the Registration Card at time of customer purchase and return it to Monitor Products, Inc. as soon as possible.

D. Remove the spill tray from shipping carton, and remove the plastic bag.
E. Remove the plastic bag covering the hearer.
F. Remove the plastic bag containing the heater parts,and set it aside.
G. Remove the Flue Pipe from the rear of the heater. When ready to install, separate Flue Pipe from cardboard packing materials.
H. Firmly grasp cabiet handles (one on each side of heater cabinet) and lift heater off the cardboard shipping base.
I. Check for parts as listed in Monitor Owners Guide.

IMPORTANT: **Only the standard-size Flue Pipe is shipped with the heater. The Monitor dealer will also stock Medium Flue Pipes, Window Kits, Extension Kits, and other accessories that may be required for non-standard installations.**

2-9 HEATER INSTALLATION

In choosing a location for your heater, the following guidelines must be considered:

- The heater MAY be installed on combustible floors.
- The area around the heater should be free of obstacles that might interfere with the free flow of air.
  Allow the clearances shown in Figure 2-1.
- The heater must not be installed in a combustible fireplace.
- An AC wall outlet must be within reach of the heater's power cord. Extension cords must not be used.
- The area outside where the flue pipe will emerge should be free of foliage, fuel storage tanks and flammable objects. Air should circulate freely in the area. Allow the clearances shown on following page.
- The wall where flue pipe hole will be cut should be free of plumbing pipes, electrical wires, studs. air ducts and other obstacles.

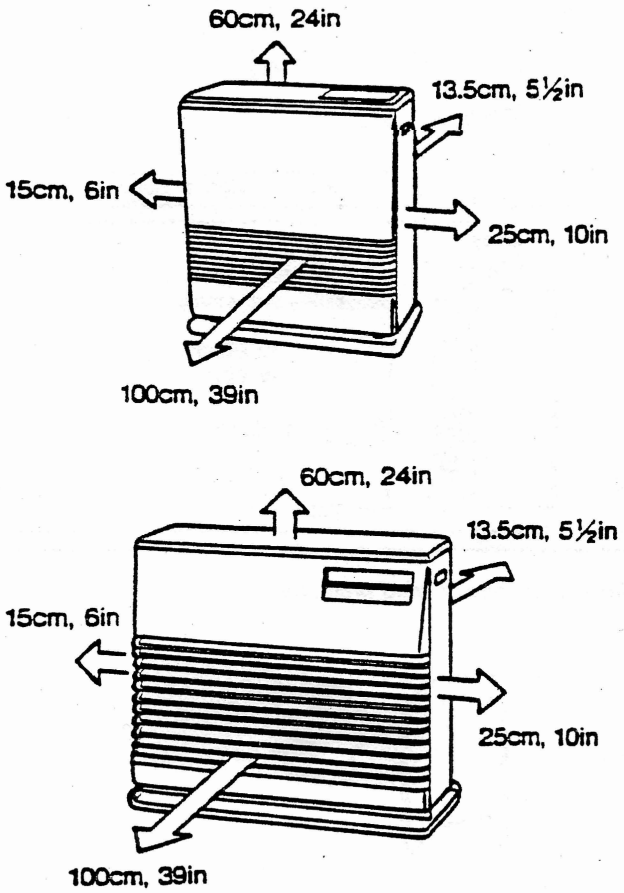

60cm, 24in
13.5cm, 5½in
15cm, 6in
25cm, 10in
100cm, 39in
60cm, 24in
13.5cm, 5½in
15cm, 6in
25cm, 10in
100cm, 39in

Figure 2-1

NOTE: After using the installation template as a guide for drilling the flue pipe hole, the Monitor Flue Pipe can be normally installed according to the Illustration procedure in the Monitor Manual.

Just in case the template was misplaced, the approximate flue pipe hole location measurements are as follows:

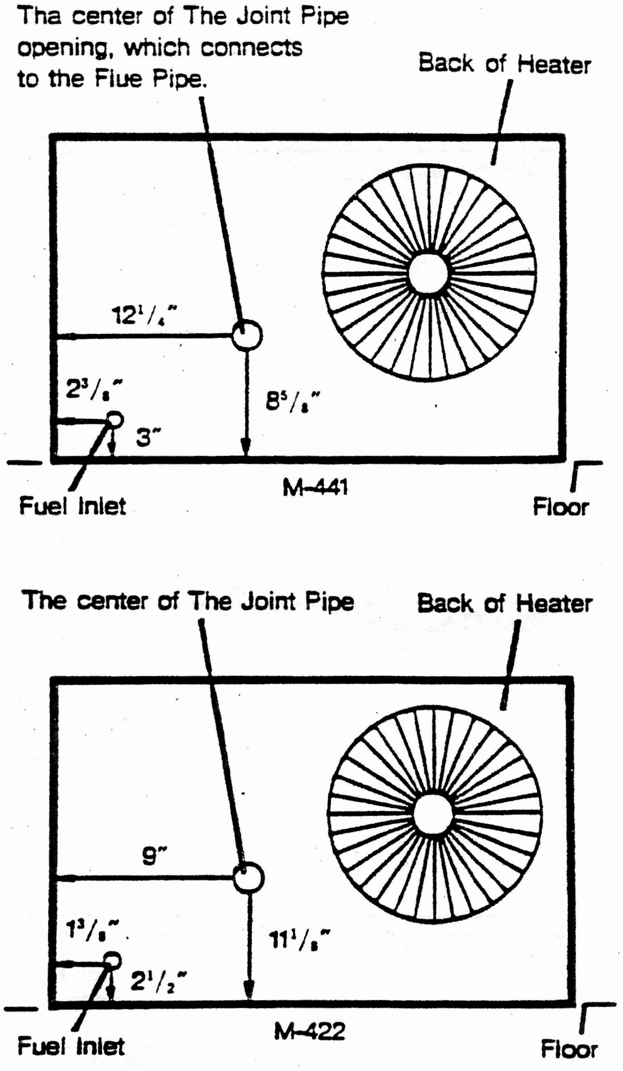

Tha center of The Joint Pipe opening, which connects to the Flue Pipe.
Back of Heater
$12\,^1/_4$"
$2\,^3/_8$"
$8\,^5/_8$"
3"
Fuel Inlet
M-441
Floor
The center of The Joint Pipe
Back of Heater
9"
$1\,^3/_8$"
$11\,^1/_8$"
$2\,^1/_2$"
Fuel Inlet
M-422
Floor

Figure 2-2

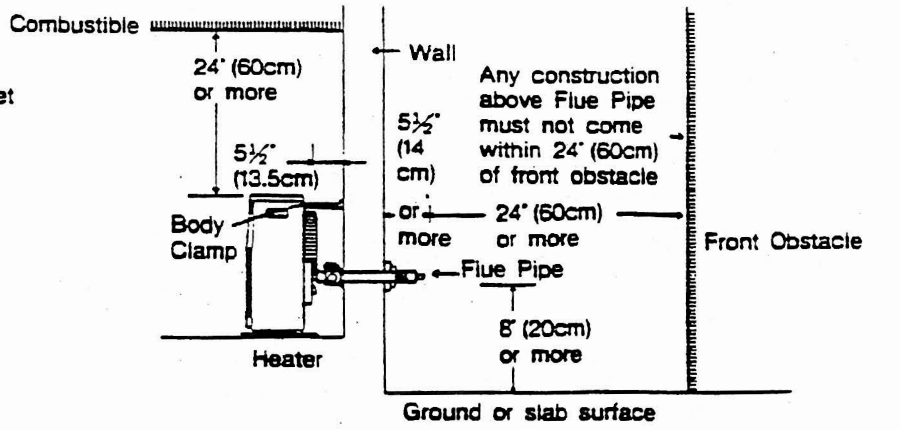
FLUE PIPE CLEARANCES

Flue pipe installations should provide for venting to an unconfined space through which there is a free flow o outdoor air. Clearances to adjacent walls or obstacles must comply with the requirements shown below.

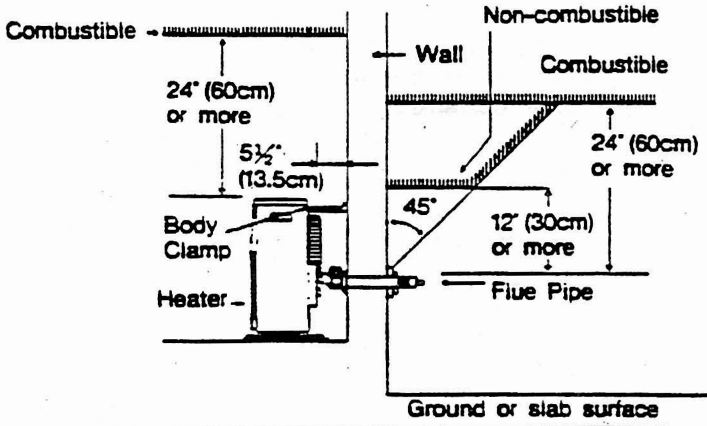
Frontal Clearance

⚠CAUTION:

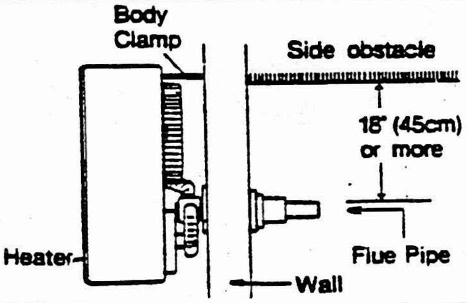
Do not attach anything onto the outlet of the flue pipe.


Combustible
24" (60cm) or more
5½" (13.5cm)
Body Clamp
Heater
Wall
5½" (14 cm) or more
Any construction above Flue Pipe must not come within 24" (60cm) of front obstacle
24" (60cm) or more
Flue Pipe
8" (20cm) or more
Front Obstacle
Ground or slab surface

Overhead Clearance


Combustible
24" (60cm) or more
5½" (13.5cm)
Body Clamp
Heater
Wall
Non-combustible
Combustible
24" (60cm) or more
45°
12" (30cm) or more
Flue Pipe
Ground or slab surface

Side Clearance


Body Clamp
Side obstacle
18" (45cm) or more
Heater
Flue Pipe
Wall

IMPORTANT:

In open area with strong wind, a wind break may be necessary.

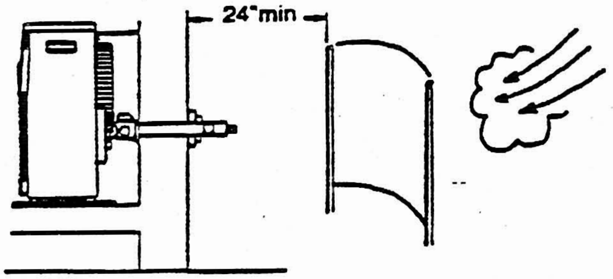
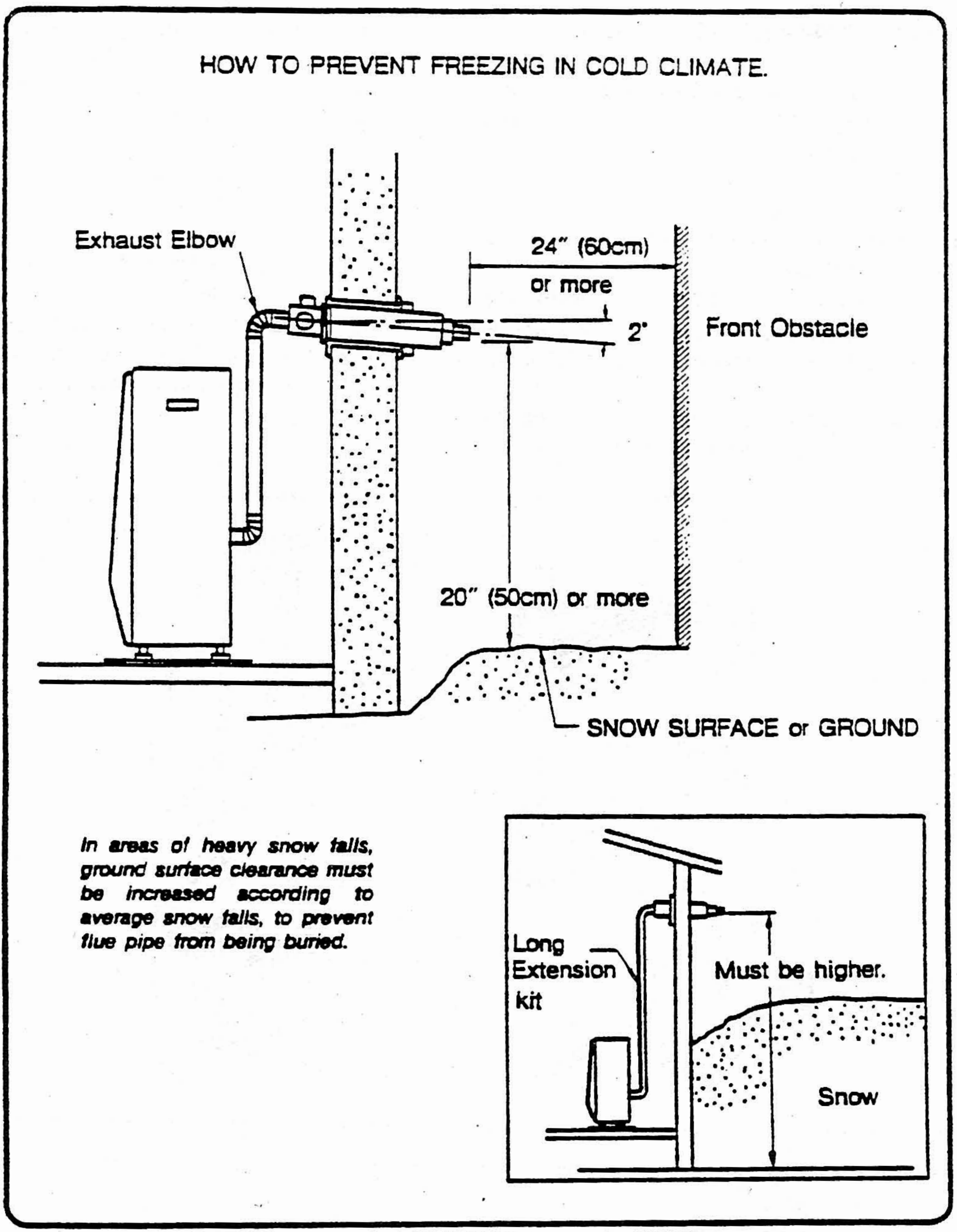


Figure 2-3

HOW TO PREVENT FREEZING IN COLD CLIMATE.



In areas of heavy snow falls, ground surface clearance must be increased according to average snow falls, to prevent flue pipe from being buried.

Figure 2-4 FLUE PIPE CLEARANCES

INSTALLATION OF FLUE PIPE WINDOW KIT

A window kit makes it possible to vent the heater from dwellings in which through-the-wall venting is neither practical nor possible.

The Window Kit is available in two sizes. The Short Window Kit accommodates windows from 20 to 32" wide; the Long Window Kit accommodates windows from 31 to 50" wide.

NOTE: The procedure below describes how a Window Kit is installed in a double-hung window. The Window Kit can also be installed in a vertical, sliding type window.

Install the Window Kit in the manner outlined below:

STEP 1: Install Flue Pipe In Window Kit

A. Push the rubber seal into the Flue Pipe hole on the window kit frame. The hole on the seal should be positioned at the exterior side of the frame.

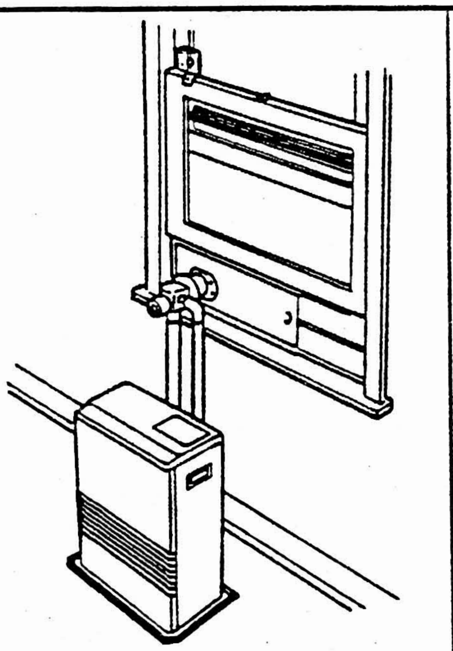
B. Using the four (4) Phillips head screws, fasten the spacer to the frame.

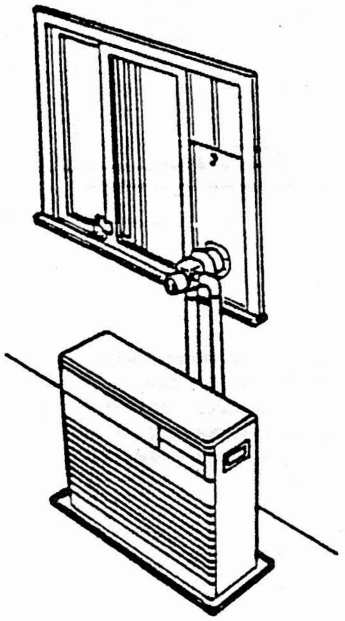
C. With the arrow on the Flue Pipe pointing UP, align the screw holes on the Flue Pipe with those on the Spacer. Secure with three (3) phillips head screws.

STEP 2: Install Window Kit in the Window

IMPORTANT: Prior to installation, clean the window frame of all dust, dirt, and debris.

A. Raise the lower window
B. Place the window kit frame into the innermost track of the window.
C. Expand the frame until it fits loosely within the width of the window; it may be necessary to loosen the large set screw on the frame in order to do so.
D. Slightly lift window kit frame. Slide the L-Adapter under the frame and position it at the point where the inner and outer frame meet.
E. Expand the frame to fit the window tightly. Adjust the position of the L-Adapter, if necessary. Tighten the set screw to secure the frame. Secure the L-Adapter to the window sill with two (2) wood screws.
F. Lower the window firmly down upon the top of the Window Kit frame.
G. Measure the width of the upper (outer) window (which is located in the outer track). Cut a length of the Rubber Packing to this size. Remove the protective backing and firmly mount it onto the underside of the outer window.





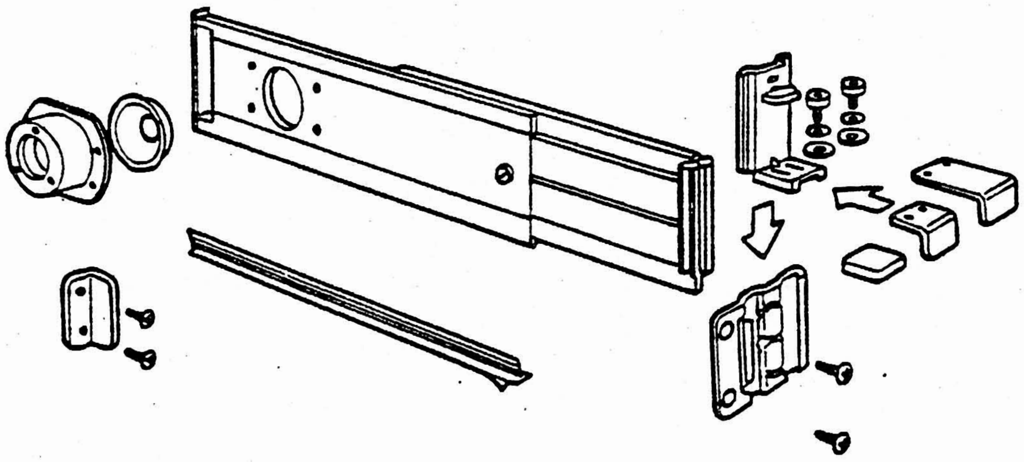


Figure 2-5

STEP 3: Install Window Lock

A special window lock replaces the usual clamshell lock.

To install the window lock, proceed as follows:

A. Turn locking lever to left and disengage lock from lock bracket.

B. Attach lock bracket to left-hand side of upper window frame. Use the two wood screws provided.

NOTE: If the lock bracket prevents the lower window from sliding upward, notch the bracket into the upper window frame.

C. Slip lock into lock bracket.

IMPORTANT: Window can be locked by turning locking lever to right; to open, turn locking lever to left and remove lock from bracket.

D. Two adjustable-position stops are supplied to accommodate various window sash thicknesses. If short stop is too small, remove two retaining screws and brackets which hold the short stop to the underside of the lock. Remove the short stop and substitute the long stop. Adjust to proper position, and secure with screws and washers previously removed. (Before securing the stop to the window, remove the protective backing and firmly stick the stop packing onto the underside of the stop.)

NOTE: Windows with deep sills may require the use of an extra intake and exhaust elbow to provide clearance for flue pipe hook up. A piece of the air intake line can be cut to join the two intake elbows together.

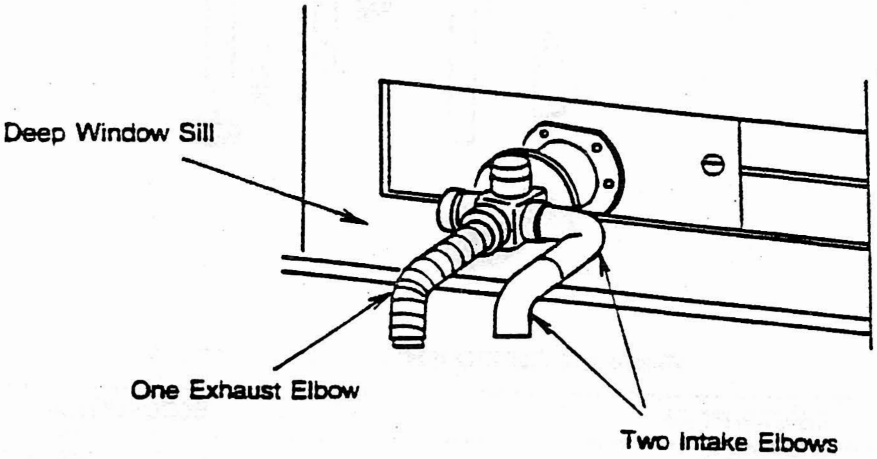


Figure 2-6

2-10 INSTALLING AN EXTENSION KIT

Installing an Extension Kit requires the construction of an air line and the exhaust line. The air line is connected between the Air Supply Elbow at the rear of the heater and the air inlet port on the Flue Pipe. Similarly, the exhaust line is connected between the joint pipe at the rear of the heater, and the exhaust port on the Flue Pipe.

IMPORTANT: **The PVC air line is longer than the exhaust line and may need to be cut to size. Be sure, however, to thoroughly deburr all rough edges.**

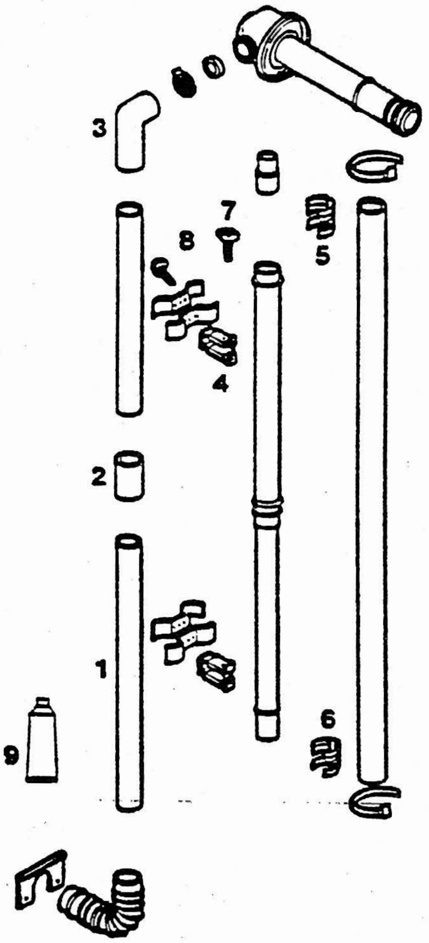
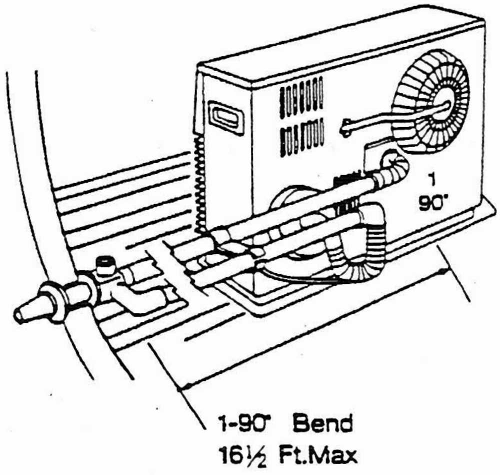


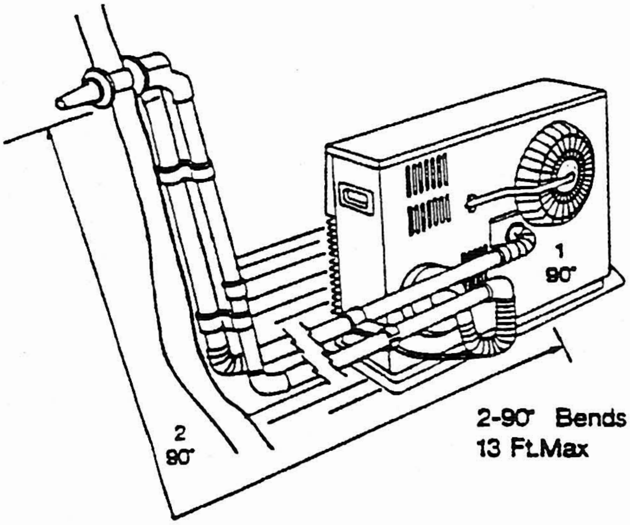
Figure 2-7 COMPONENTS OF EXTENSION KIT

ITEM#	DESCRIPTION	ITEM#	DESCRIPTION
1	PIPE, Air supply	6	PIPE CLAMP, Bottom
2	JOINT, Air line	7	SCREW, Legs, mounting
3	ELBOW 90° Air line	8	SCREW, Pipe Clamp
4	LEG, Wall-standoff	9	BOND, Adhesive
5	PIPE CLAMP, Top		

Max lengths and bends allowable using extension kits.

Extension kits are available in four different lengths. For exact dimensions refer to the accessories catalog.


1
90°
1-90° Bend
16½ Ft.Max


1
90°
2
90°
2-90° Bends
13 Ft.Max

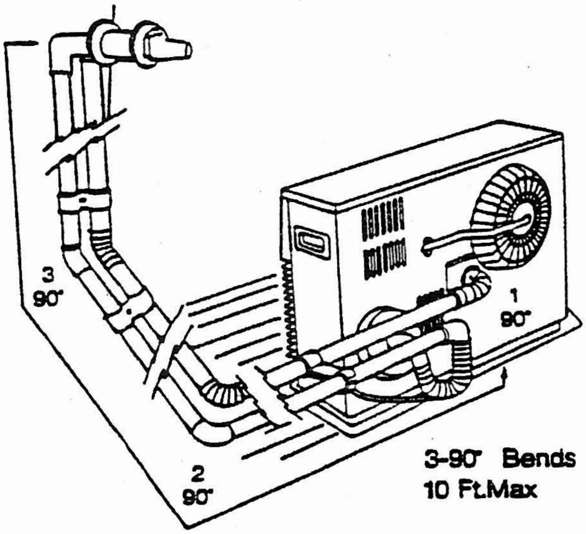
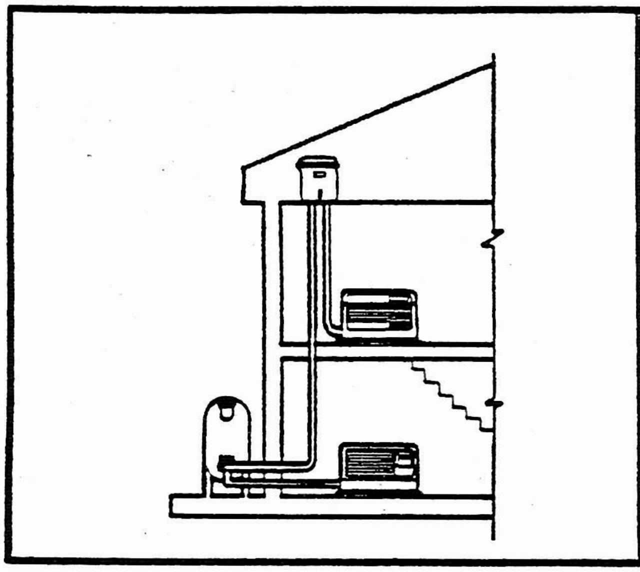

1
90°
2
90°
3
90°
3-90° Bends
10 Ft.Max

Figure 2-8 MAX LENGTHS AND BENDS ALLOWABLE USING EXTENSION KITS

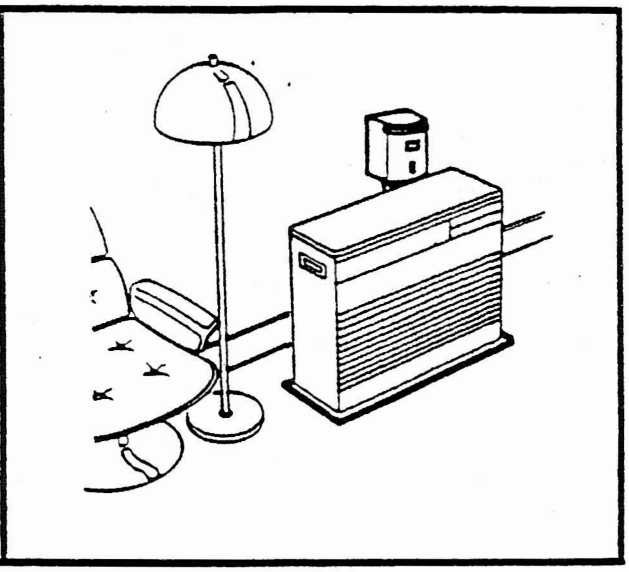
2-11 TYPICAL MONITOR LIFTER PUMP INSTALLATIONS

For more detailed information look under Kerosene Lifter manual.

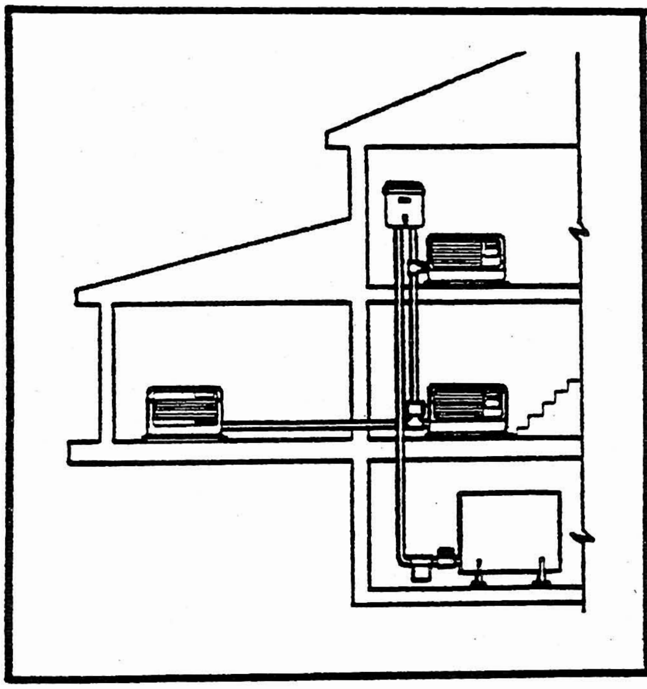
NOTE: The same minimum and maximum pump heights must be maintain as is with other fuel tanks. Figure 2-12



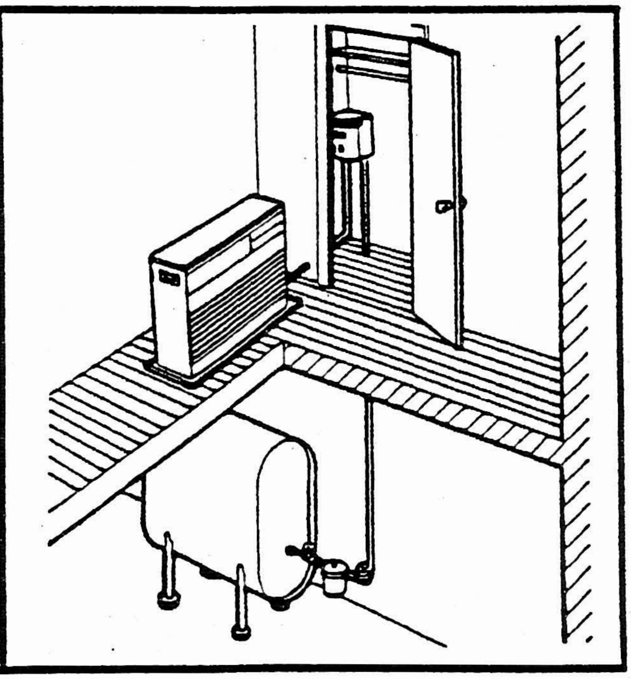
MONITOR™ KEROSENE LIFTER



MONITOR™ KEROSENE LIFTER
(CAN BE POSITIONED BEHIND UNIT)



MONITOR™ KEROSENE LIFTER



MONITOR™ KEROSENE LIFTER/GRAVITY

Figures 2-9

2-12 USES FOR THE ELBOW ADAPTER KIT

Convert from Monitor 20/30 to 422/441 using an elbow adapter Kit (part # 8213) and utilizing existing flue pipe installation.

PARTS LIST EXPLODED

Ref. No.	Name of Part	No in Unit
1	Exhaust Pipe Clamp	
2	Exhaust Elbow	1
3	Exhaust Joint	1
4	Joint Supporter	1
5	Heat Insulation Cover	1
6	Self-Tapping Screws	2
7	Hose Clamp (this part comes with your Monitor™ Heater)	
8	Air Damper (this part comes with your Monitor™ Heater)	
9	Flue Pipe (this part comes with your Monitor™ Heater)	

A. Remove Monitor 20/30 heater and flue pipe.
B. Install Monitor 422/441 flue pipe into sleeve.
C. Slide the exhaust elbow onto the exhaust port opening on the rear of the heater. (To locate exhaust port opening, see your Monitor Owner's Guide.)
D. Secure the exhaust elbow by attaching the exhaust pipe clamp to the heater cabinet with two self-tapping screws.
E. Cover the adjustable exhaust pipe with heat insulation cover.

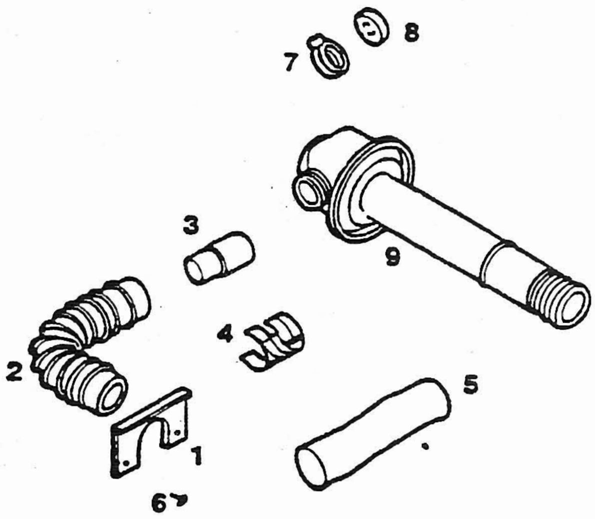


Figure 2-10

F. Remove metal cap on side mounted exhaust port of flue pipe and replace into the port (the Monitor 422/441 is now ready to be positioned into place.)

NOTE: Be sure the exhaust elbow is firmly fixed on the flue pipe with a joint supporter.

G. Insert air supply elbow opening over flue pipe air intake flange and secure with hose clamp.

NOTE: The Standard Air Damper is installed over the flue pipe "air intake flange." (To locate flue pipe "air intake flange", see your Monitor™ Owner's Guide.)

Elbow adapter kits may also be used to raise a flue pipe high enough to clear certain base board heating systems.

2-13 FUEL TANK INSTALLATION

Pictorial views of alternative types of storage facilities and delivery systems are illustrated (Figure 2-12).

Since fuel storage tank installation techniques vary from place-to-place (often dependent upon applicable codes), a particular installation procedure cannot be specified. However, certain criteria govern the fuel hook-up of the Monitor. Use the following check list as a guide to the fuel storage facilities:

WARNING:

USE ONLY CRYSTAL CLEAR KEROSENE. NEVER USE GASOLINE, WHITE GAS, CAMP FUEL OR OTHER FLAMMABLE LIQUIDS. USE OF SUCH FUELS CAN RESULT IN AN EXPLOSIVE FIRE AND CAUSE SEVERE INJURY.

Fueling Options Available

Fueling of the Monitor Heating Systems can be accomplished in one of 3 ways:

1. Capsule Tank (on the Monitor 422)
2. Gravity Fed Large Capacity External Tank: Practical for large heating needs where bulk delivery of kerosene is available. This system should be installed by a qualified plumber or fuel supply technician.
*3. Large Capacity External Tank with Pump: For large heating needs where a gravity fed system is not practical. An electric pump, the Monitor™ Kerosene Lifter, especially designed for use with Monitor heating systems.

*if a pumping system is used to supply fuel, the inlet pressure to the heater must not exceed 2.5psi.

To install a large capacity, gravity fed external tank, follow the instructions below. Use of a qualified installer is recommended.

- Installation height of the bottom of the fuel tank should be 16 inches or more above the floor surface on which the heater stands. This insures that inlet fuel pressure will be sufficient. The top of the fuel tank should be no higher than $8^1/_2$ feet above the floor under the heater. This insures that inlet fuel pressure will not be excessive.
- The horizontal length of piping should not exceed 100 feet and should be free of sharp bends or obstructions.
- Piping should include no inverse U-type bends (to avoid air locks, which could block the fuel supply).
- Only $^3/_8$-inch OD copper tubing should be used. The tubing should be bent carefully to avoid crimping.
- A fuel filter is recommended for use on the fuel line near tank, and a shut-off valve should be installed at the tank.
- Flare connections should be used at the fusible link valve connection on the heater and at the fuel filter to be installed at the tank.
- The fuel tank should be located no closer than 6 feet to a source of heat.
- The fuel tank should have an opening for filling on the top and a vent with a weather-proof cap on the side. On some tanks the vent and fill spout use the same opening.

55, 100, and 250 gallon tanks must contain:

- Shut-off valve at tank outlet
- Disposable fuel filter (protects heater against condensation and other impurities)
- Fueling inlet (protected by weather-proof cap)
- Ventilation outlet
- Clearance of at least 3′ from any source of heat

Allowable Height Dimensions:

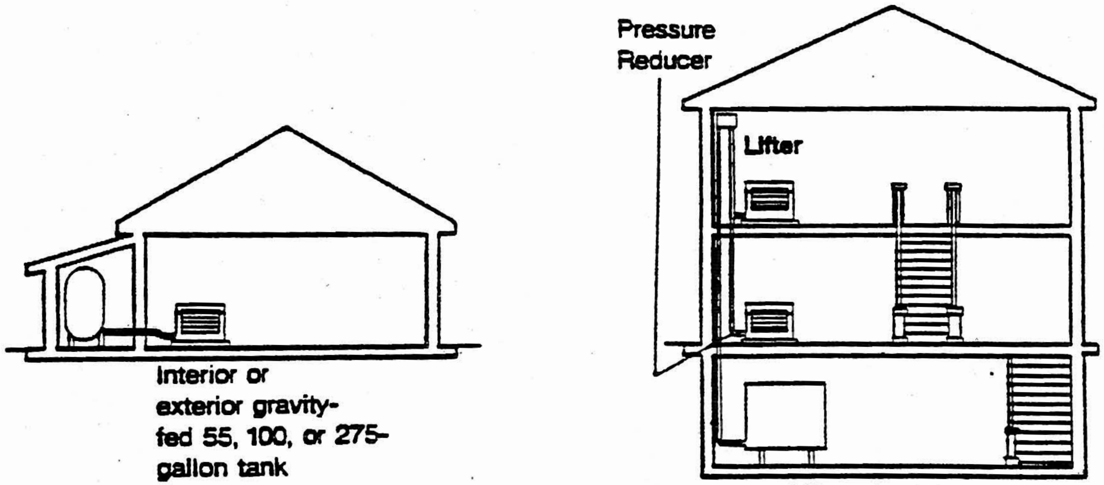
- Bottom of tank-at least 16″ above floor holding heater (maintains sufficient pressure)
- Top of tank-maximum of $8^1/_2$′ above floor holding heater (prevents excessive line pressure above 2.5 psi).
- Position of Lifter-more than 8′ above fuel inlet of heater requires pressure reduction valve.

RECOMMENDATION

Pipe fittings in the fuel supply to the Monitor heating systems should be sealed with pipe thread tape. The supply line from the tank to the Monitor™ Kerosene Lifter must be absolutely air tight. 275 gallons and bigger tanks should have a 2.5 P.S.I. max pressure reducer to avoid excessive pressure at heater inlet.

2-14 HEATER INSTALLATION

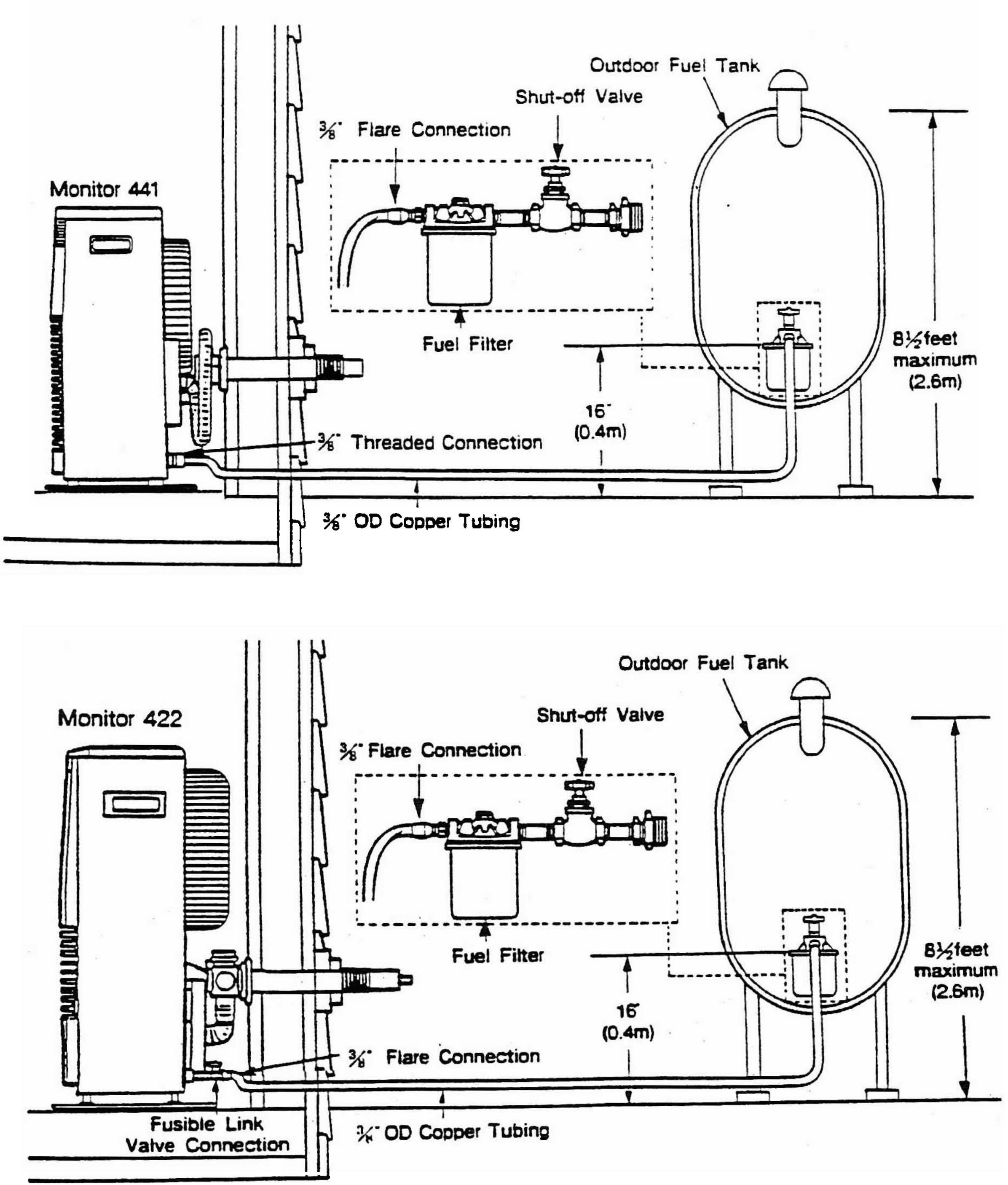
The Monitor heaters can be physically situated on carpeting or other combustible flooring with complete safety. The selected heater site must be accessible to an electrical outlet, must support free air ciculation (both internal and external), and must not contain combustible materials in the heater's immediate vicinity.



Interior or exterior gravity-fed 55, 100, or 275-gallon tank

Lifter circulates fuel from remote storage tank

Figure 2-11 ALTERNATIVE SOURCES OF FUEL STORAGE


Outdoor Fuel Tank
Shut-off Valve
⅜" Flare Connection
Monitor 441
Fuel Filter
8½feet maximum (2.6m)
16" (0.4m)
⅜" Threaded Connection
⅜" OD Copper Tubing
Outdoor Fuel Tank
Monitor 422
Shut-off Valve
⅜" Flare Connection
Fuel Filter
8½feet maximum (2.6m)
16" (0.4m)
⅜" Flare Connection
Fusible Link Valve Connection
⅜" OD Copper Tubing

NOTE: Fuel tank must be a minimum 3 feet away from flue pipe.

Figure 2-12 TYPICAL FUEL LINE CONNECTIONS

3-1 INTRODUCTION

Monitor is an easy-to-operate vented kerosene heater. Routine operation features high BTU output. automatic adjustment of room temperature, low fuel and power consumption, and choice of automatic or manual heater operation.

This section provides all information necessary to operate the Monitor Heating System. All operation procedures specified should be performed in the order in which they are described.

3-2 OPERATING SPECIFICATIONS

The following specifications apply to the operation of the Monitor 441 and the Monitor 422.

Monitor 441

- Rated Efficiency (as applied to kerosene heaters): 93%*
- Rated Efficiency (as applied to central heating systems): 87%
- Power Consumption : as follows

IGNITION	HIGH BURN	MEDIUM-HIGH BURN	MEDIUM-LOW BURN	LOW BURN
340watts	65watts	62watts	58watts	58watts

- Circulation Fan Output : 388 cubic feet/min.
- Fuel source : Remote, separate tank
- Potential heating area : 900-3200 sq. feet

*The energy from the combustion process is released in the form of heat and vaporized water. Normally, heating systems discharge water from combustion to the atmosphere without condensing it. This 93% efficiency rating means that, assuming the water cannot be condensed, 93% of the heat produced by the combustion process is recovered. Assuming the water can be condensed, the efficiency is 87%.

NOTE: Actual effective heating area depends upon numerous factors such as type and severity of climate, type of dwelling construction, condition of dwelling, and thickness and effectiveness of dwelling insulation.

Table 3-1 lists Monitor 441 performance specifications at various user-selected heat output settings.

Table 3-1 HEATER PERFORMANCE SPECIFICATIONS

Specification	Setting			
	Low	Medium Low	Medium High	High
Rating	16,200	21,000	33,900	43,000
Heater Output/hr.	15,000	19,500	31,500	40,000
Fuel Consumption (gal/hr)	0.12	0.16	0.25	0.319
8-hrs/day burntime (5-gal. tank)	5.2days	3.9days	2.5days	2.0days
Continuous-use burntime (5-gal.tank)	41.7hrs.	31.3hrs.	20hrs.	15.7hrs.
8-hrs/day burntime (55-gal.tank)	57.3days	43days	27.5days	21.6days
Continuous-use burntime (55-gal.tank)	19.1days	14.3days	9.2days	7.2days
8-hrs/day burntime (275-gal.tank)	286.5days	214.8days	137.5days	107.8days
Continuous-use burntime (275-gal.tank)	95.5days	71.6days	45.8days	35.9days

Monitor 422

- Rated Efficiency (as applied to kerosene heater): 93%*
- Rated Efficiency (as applied to central heating systems): 87%
- Power Consumption : as follows

IGNITION	HIGH BURN	MEDIUM-HIGH BURN	MEDIUM-LOW BURN	LOW BURN
250watts	52watts	51watts	50watts	50watts

- Circulation Fan Output : 176 cubic feet/min
- Fuel source : 1.32 U.S. gal., separate tank optional
- Potentional heating area : 600-2000 sq. feet

Table 3-2 lists Monitor 422 performance specifications at various user-selected heat output setting.

Table 3-2 HEATER PERFORMANCE SPECIFICATIONS

Specification	Setting			
	Low	Medium Low	Medium High	High
Rating	9,600	11,700	17,400	22,000
Heater Output/hr.	8,900	10,900	16,200	20,400
Fuel Consumption (gal/hr)	0.07	0.09	0.13	0.164
8-hrs/day burntime (1.32-gal. tank)	2.4days	1.8days	1.3days	1.0days
Continuous-use burntime (1.32-gal.tank)	18.9hrs.	14.7hrs.	10.2hrs.	8.0hrs.
8-hrs/day bmtime (55-gal.tank)	98.2days	76.4days	52.9days	41.9days
Continuous-use burntime (55-gal.tank)	32.7days	25.5days	17.6days	14.0days

NOTE: Capsule tank cannot be used in Connecticut and Massachusetts.

3-3 OPERATING CONTROLS AND INDICATORS

Several controls and indicators are used to operate the heater and to monitor its performance as follows:

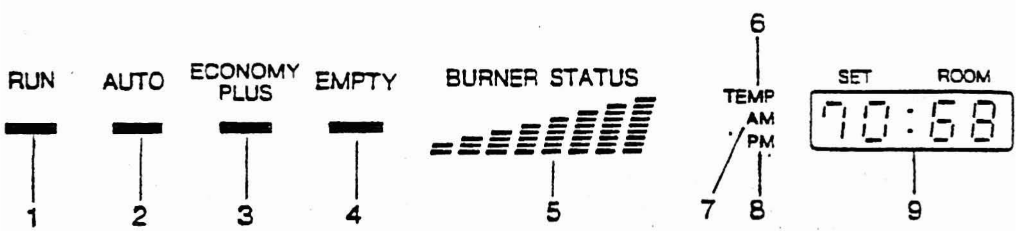

RUN
AUTO
ECONOMY PLUS
EMPTY
BURNER STATUS
6
TEMP
AM
PM
SET
ROOM
70:68
1
2
3
4
5
7
8
9

Figure 3-1, INDICATORS

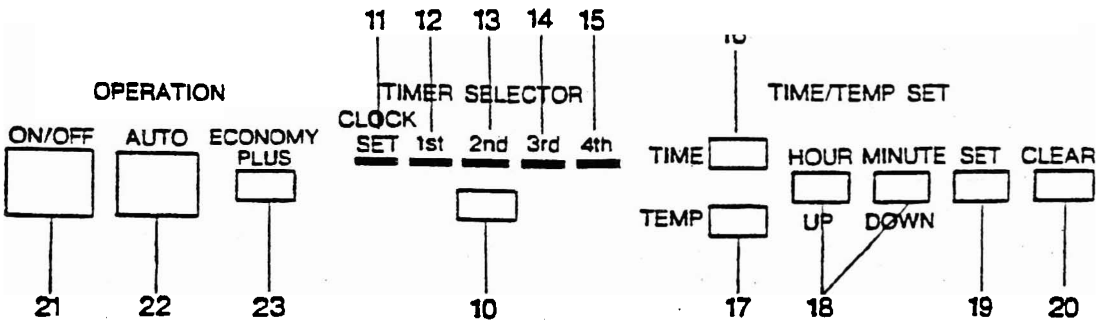

11
12
13
14
15
OPERATION
TIMER SELECTOR
CLOCK
SET
1st
2nd
3rd
4th
TIME/TEMP SET
ON/OFF
AUTO
ECONOMY PLUS
TIME
TEMP
HOUR
MINUTE
SET
CLEAR
UP
DOWN
21
22
23
10
17
18
19
20

Figure 3-2, CONTROLS

FIGURE AND ITEM NO	CONTROL OR INDICATOR	FUNCTION
Figure 3-1, Item1	RUN Indicator Light	Light to indicate that power has been aplied to heater. Illuminates when operation ON/OFF push-button switch is pressed to position ON
Figure 3-1, Item2	AUTO Indicator Light	Lights when heater runs in automatic mode. AUTO, RUN, and appropriate BURNER STATUS Indicators are illuminated simultaneously if heater is burning.
Figure 3-1, Item3	ECONOMY PLUS Indicator Light	Lights when heater runs in Economy Plus mode.
Figure 3-1, Item4	Empty Indicator Light	In case of using the cartridge tank, when the fuel is empty, EMPTY Indicator Light blinks. This Light is not provided with Monitor 441.
Figure 3-1, Item5	BURNER STATUS Indicator Lights	Light in accordance with heat output as follows:

Heat Output	Light Pattern
High	8indicators-ON
Medium High	6indicators-ON
Medium Low	4indicators-ON
Low	2indicators-ON

FIGURE AND ITEM NO	CONTROL OR INDICATOR	FUNCTION
Figure 3-1, Item6	TEMP Indicator Light	Lights when heater is running and Digital Window is showing the temperature.
Figure 3-1, Item7	AM Indicator Light	
Figure 3-1, Item8	PM Indicator Light	
Figure 3-1, Item9	Digital Display	Indicates SET and ROOM temperature when heater is running, and indicates time when heater is Off. Indicates time and temperature for automatic operation setting.
Figure 3-2, Item10	TIMER SELECTOR push-button switch	The automatic function allows the programming of different temperatures for different times of the day. Two, three or four settings can be used.
Figure 3-2, Item11	CLOCK SET Indicator Light	Allows programming of current time when illuminated. **NOTE:** Prior to programming current time, Digital Display shows 88:88. **IMPORTANT: Once current time has been programmed, press the SET pushbutton switch within 60 seconds. Otherwise clock display will revent to previously programmed time, if any.**
Figure 3-2, Item12	1st Indicator Light	Allows programming of first automatic time and temperature selection when illuminated. When programmed, heater automatically operates at specified time and temperature (i.e. 6: 00 a.m., 70°F), if set for AUTO, providing that heater has been set for automatic mode of operation. TIME, TEMP, HOUR(UP), MINUTE(DOWN) and SET push-button switches are used to program first operated time and temperature. **IMPORTANT: Once time and temperature have been programmed, the SET push-button switch must be pressed with in 15seconds. Otherwise, time and temperature will revert to previously programmed time, if any.** When this Light illuminates, 1st presently programmed time and temperature displayed.
Figure 3-2, Item13	2nd Indicator Light	Allows programming of second automatic time and temperature selection when illuminated.

FIGURE AND ITEM NO	CONTROL OR INDICATOR.	FUNCTION
Figure 3-2, Item14	3rd Indicator Light	Programs 3rd automatic heater operation as same as 1st Indicator Light.
Figure 3-2, Item15	4th Indicator Light	Programs 4th automatic heater operation as same as 1st Indicator Light.
Figure 3-2, Item16	TIME push-button switch	This switch is used to set time and change display over.
Figure 3-2, Item17	TEMP push-button switch	This switch is used set temperature and change display over, in 2 degree increments.
Figure 3-2, Item18	HOUR/UP, MINUTE/DOWN repetitive-action push-button switch	Programs time or temperature. **NOTE:** Each time push-button switch is pressed, the digit advances in increments of one digit. If push-button is pressed and held, the digits are advanced repetitively.
Figure 3-2, Item19	SET push-button switch	"Sets" time and/or temperature. If this control is not pressed after time and/or temperature have been programmed, the time and/or temperature programmed (as indicated by display window) will not be accepted, and will revert to previously programmed time and/or temperature.
Figure 3-2, Item20	CLEAR push-button switch	Erases any programmed time and temperature. When cleared, time and/or temperature previously programmed and displayed disappear(s) from window. IMPORTANT: **Both current time and automatically programmed time(s), temperature(s) will have to be reprogrammed if electrical operation is interrupted by power failure or by disconnecting heater plug from wall outlet beyond 5 minutes. If this occurs, the heater will go into MANUAL mode of operation and maintain room temperature according to the setting temperature you've selected by using the slide selector for the reset temperature at the lower right hand side of the cabinet.**
Figure 3-2, Item21	ON/OFF push-button switch	ON position (push-button is "in")applies power to the unit. When this occurs, the RUN indicator lights to indicate that heater operation has begun. OFF position (push-button is "out") remove power from the heater. All circuits-except for Clock and Air Flow — are shut down.

FIGURE AND ITEM NO	CONTROL OR INDICATOR.	FUNCTION
Figure 3-2, Item22	AUTO push-button switch	Places heater in automatic mode of operation. AUTO indicator lights to confirm automatic operation. Assuming that the heater has been properly programmed and heater is in ON position, heater will operate automatically. When pressed again, AUTO indicator goes out and then heater will operate in MANUAL mode. During manual operation, the user turns heater ON and OFF, at will. When AUTO is disengaged, the unit will operate on a manual temperature determined by the AUTO setting for that time of day.
Figure 3-2, Item23	ECONOMY PLUS push-button switch	Places heater in Economy Plus mode of operation. ECONOMY PLUS indicator lights to confirm Economy Plus operation. When pressed again, ECONOMY PLUS indicator goes out and then Economy Plus mode will be cancelled. **NOTE:** Economy Plus mode is accepted only in the MANUAL mode.

3-4 PRE-OPERATION CHECK LIST

After heater installation, but prior to Monitor heater start-up, inspect the system for operational readiness. The following check list specifies those items that should be inspected on a routine basis:

- ✓ Check that the Monitor heater is plugged into wall outlet (120 Vac, 60 Hz)
- ✓ Verify that adequate supply of kerosene is available in fuel tank
- ✓ Confirm that fuel is free of water or other contaminants
- ✓ Check fuel tank for good operating condition; it must be free of rust, corrosion, and/or leaks
- ✓ Inspect Fuel Line for signs of leaks, loose connections, cracks, air pockets or blockages
- ✓ Confirm that Fuel Valves on Fuel Tank and Fusible Link Valve are open so fuel can flow freely
- ✓ Outside dwelling, check area immediately around Flue Pipe for combustibles or obstructions to free air circulation
- ✓ Inspect Air Line for cracks, loose connections or blockage
- ✓ Check Exhaust Line for cracks, loose connections or blockage
- ✓ At rear of heater, verify that air flow to the Air Circulation Fan is not blocked

  Inspect dwelling interior and confirm that immediate area near heater is free of combustible and objects that might interfere with free air flow.
- ✓ Make certain that Heat Sensor is not exposed to drafts, direct sunlight, nor direct heat from the Monitor.
- ✓ Confirm that heater is level

If this inspection reveals any system deficiencies, correct the problems before operating the heater.

3-5 OPERATION

Operation of Monitor heater can be controlled manually by the user, or run automatically by the microprocessor.

Paragraphs 3-6 through 3-10 provide the details of heater start-up, operation, and shutdown. The controls and indicators illustrated by Figure 3-1 and 3-2 are used to operate the system and to monitor the heater's performance.

3-6 MANUAL HEATER OPERATION

Operation of the heater is under the direct control of the user (heater will not operate automatically). The heater will, however, automatically respond to changes in room temperature signaled by the Heat Sensor to maintain the temperature of the room at a comfortable level.

NOTE: Resetting the Fuel Constant Level Valve is necessary only if the heater is being started for the first time, hasn't been used for an extended period of time, or if tank has run empty. If priming is unnecessary skip to step 2.

STEP1: Prime the Heater

Gently press and release the Fuel Constant Level Valve Reset Lever four or five times.

STEP2: Select Manual Operation

If heater operation is in AUTO mode, press the AUTO push-button switch and change Auto to Manual mode.

STEP3: Select Temperature Setting

Press the TEMP push-button switch and press either the UP or DOWN push-button switch to set the digital set room temperature indicator to the desired temperature, and then press the SET push-button switch.

IMPORTANT: In case no temperature is set, temperature will automatically be set at the setting temperature selected by using the slide selector for the reset temperature.

STEP4: Turn Monitor On

Press the ON/OFF push button switch to position ON. The RUN indicator light illuminates to indicate that power has been applied to the instrument and the heater is cycled for manual mode of operation.

INSTRUCTIONS FOR ECONOMY PLUS MODE

To engage the economy plus mode, simply press down the button labeled "Economy Plus", to disengage press again.

NOTE: Operation switch must be "ON" and in MANUAL mode.

This feature minimizes the "ON " and "OFF" cycling of the unit by allowing it to overshoot the set temperature by 12 degrees instead of the normal 4 degrees.

The advantages of this feature are to increase the overall efficiency of the unit by:

1. Decreasing electrical consumption by decreasing the frequency of ignition cycles.
2. Reducing heat loss during the prepurge and postpurge cycles.
3. Reducing inefficient combustion associated with start up and shut down.
4. Prolonging component life by decreasing expansion and contruction of internal parts.

NOTE: This feature could be compared to driving an automobile in stop and go traffic (regular mode) versus highway driving with cruise control engaged (Economy Plus mode).

3-7 AUTOMATIC HEATER OPERATION

Automatic operation is established by programming the time/temperature settings for specific times. On a daily basis, a maximum of four time/temperature settings can be programmed.

If, subsequently, it should be desired to switch to manual mode of operation, the changeover can be made at any time.

Proceed with automatic mode of operation in the following manner:

STEP1: Program Clock for Current Time

A. Press the TIMER SELECTOR push-button switch, at which time the CLOCK SET indicator light will illuminate.
B. Press HOUR push-button switch to program current hour on the Clock.

IMPORTANT: Be sure to set clock for AM or PM, as appropriate.

NOTE: Both hour and minute digits on Display Window are advanced in increments of one by pressing the appropriate push-button switch one time for each digit; digits can also be advanced repetitively by pressing and holding the appropriate push-button switch.

C. Press MINUTE push-button switch to program the current minute(s) on Clock.
D. Immediately after programming current time in terms of hours and minutes, press the SET push-button switch.

STEP2: Program the 1st Time Temperature

A. Pressing the TIMER SELECTOR push-button switch will illuminate the 1st indicator light.
B. Press TIME push-button switch.

C. Press HOUR and MINUTE push-button switches to program 1st desired time.

IMPORTANT: Be sure to set the clock AM or PM, as appropriate.

D. Immediately after programming the 1st desired time, press the SET push-button switch. This step must be completed within fifteen seconds after programming the time.
E. Press TEMP push-button switch.
F. Press UP and/or DOWN push-button switch(es) to program 1st desired temperature.
G. Immediately after programming the 1st desired temperature, Press the SET push-button switch. This step must be completed within fifteen seconds after programming the temperature.

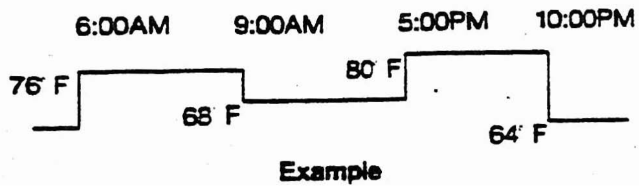
STEP3: Program the Remaining Times
By pressing the TIMER SELECTOR push-button switch again, the 2nd Indicator Light will illuminate, at which time the 2nd setting can be programmed. Press again to set 3rd and again to set 4th.

IMPORTANT: The SET push-button switch must be pressed after each setting to lock into memory.
Should heater power be interrupted by a power failure or by disconnection of the power cord beyond 5 minutes, heater reverts to MANUAL operation, and all AUTO programming is erased.

STEP4: Select Automatic Operation
Press AUTO push-button switch. The AUTO indicator light will illuminate.

STEP5: Turn Monitor ON
Press ON/OFF push-button switch to position ON. The RUN indicator light will illuminate to indicate that power has been applied to the heater.

From this point, heater operation is as follow example:



Example

3-8 REPROGRAMMING THE MONITOR HEATER
On occasion, it may be necessary to reprogram the Monitor.
Reprogramming is performed as specified below:

STEP1: Reprogramming Current Time
(if necessary)
A. Press the TIMER SELECTOR push-button switch to illuminate the CLOCK SET indicator light.
B. Press HOUR and MINUTE push-button switches to program new current time. Set applicable time by watching Clock display.
C. Press SET push-button switch.

IMPORTANT: If SET push-button switch is not pressed, current time will revert to previously programmed time.

STEP2: Reprogramming Automatic Operation
A. Press the TIMER SELECTOR push-button switch to illuminate the appropriate indicator light. (1st, 2nd, 3rd, or 4th)
B. Press TIME push-button switch.
C. Press CLEAR push-button switch. Time displayed on window will disappear.
D. Using HOUR and MINUTE push-button switches program new desired time by watching the Display Window.
E. Press SET push-button switch.
F. Press TEMP push-button switch.
G. Press CLEAR push-button switch. Set Temperature displayed on Window will disappear.
H. Using UP and DOWN push-button switches program new desired temperature by watching the Display Window.
I. Press SET push-button switch.

3-9 HEAT SENSOR
Heat Sensor is located on the rear of the cabinet. It is recommended to leave the sensor in its original mounted position. However should relocation be necessary, choose a location for the sensor that is not in the path of direct sunlight, drafts or the flow of warm air from the heater. Loosen the screw and release the sensor from the rear of the cabinet. Fasten the sensor to the wall with the screw.

3-10 MONITOR SHUTDOWN
A simple one-step procedure is utilized to shutdown the Monitor.

Press ON/OFF push-button switch to position OFF; the RUN indicator will extinguish.

IMPORTANT: Once heater has shut down, it cannot be restarted until post-purge cycle has been completed. If ON/OFF switch is left in position ON, Monitor operation will automatically restart upon completion of post-purge.

3-11 OUT OF FUEL

During either manual or automatic operation of heater, fuel in the tank may be depleted.

The Monitor (in case of using external fuel tank) is known to be out of fuel when all of the following symptoms are present:

- — Burner Status indicator lights blink.
- — Absence of flame (visually verified through view plate on wall of Combustion Chamber).

STEP1: Turn Heater OFF
Press ON/OFF switch to OFF.

STEP2: Fill Fuel Tank

A. Close shut-off valve at outlet of Fuel Tank.
B. Drain Fuel Tank (from bottom, if possible) to remove all condensation, debris, and old fuel.
C. Fill Fuel Tank with fresh, crystal clear kerosene.
D. Upon completion of stepC, open shut-off valve which was closed in stepA above.

STEP3: Turn Heater ON
Press ON/OFF switch to ON. Proceed with normal heater operation.

The Monitor 422 (in case of using capsule fuel tank) is known to be out of fuel as follows:

> When the EMPTY indicator light illuminates and flashes, a buzzer will sound for twenty seconds. The burner mode is changed to "Low" automatically, and then, the heater will shut off after 30 minutes.
>
> The remaining burning time is indicated at the Display Window.

Refueling:

STEP1: Turn Heater OFF
Press ON/OFF switch and wait 15 minutes for the heater to cool.

STEP2: Lift Out the Capsule Fuel Tank
Open the tank cover and lift out the capsule fuel tank.

Turn the tank upside down, and remove the fuel cap.

STEP3: Fill the Capsule Fuel Tank
Fill the capsule fuel tank with fresh, crystal clear kerosene by using a siphon.

STEP4: Reinstall the Capsule Fuel Tank
Replace and tighten the fuel cap. To insure proper fuel flow, be sure the cap is secured correctly. Install the tank with the arrow pointing forward, and close the tank cover.

STEP5: Turn Heater ON
Press ON OFF switch to ON. Proceed with normal heater operation.

3-12 RECOVERY FROM A POWER FAILURE

For the power interruption of up to 5 minutes, the set memory is kept and will resume operation automatically with the set memory.
For power interruptions beyond 5 minutes, heater will resume operation (after a 3 minutes cool down period) in the MANUAL mode and maintain room temperature according to the setting temperature selected by using the SLIDE SELECTOR for the reset temperature at the lower right hand side of the Cabinet.
When the TIME push-button switch is pressed or the TIMER SELECTOR push-button switch is pressed to illuminate the CLOCK SET indicator light, the Display Window will show 88:88 indicating the need to reset the clock and re-program the heater for automatic operation.

REMARK: In order to display reset temperature, it should be set before the heater is plugged in and energized.
New reset temperature selected after plugged in will take effect only after a power loss.

3-13 RECOVERY FROM OVERHEAT CONDITION

The Monitor is protected against damage resulting from an overheat condition by two 110℃ (Monitor 422), 115°C (Monitor 441) automatic reset thermostats.

In the event of an overheat the thermostats are triggered to cut off the flow of kerosene to the Burner Pot, the flame is extinguished automatically, and user is alerted to the overheat condition by blinking of the Burner Status indicators.

To recover from an overheat condition, proceed as outlined below:

STEP1: Turn OFF Heater

STEP2: Allow Monitor Heater to cool

NOTE: Be sure that heater is cool to touch.

A period of 30 to 45-minutes should be sufficient to permit heater to cool completely.

STEP3: Unplug Heater
Disconnect heater power cord from wall outlet.

STEP4: Check for Cause of Overheating

NOTE: Overheating is usually caused by objects that impede free air circulation.

Look for debris and other obstructions at front of heater, at Circulation Fan at rear of the heater, and at Flue Pipe tip outside dwelling.

STEP5: Remove Louver Assembly

STEP6: Clean Heater Interior

WARNING:

BEFORE PROCEEDING TO CLEAN HEATER, BE SURE THAT HEATER INTERIOR IS COOL ENOUGH TO TOUCH.

With a clean, lint-free, damp rag or other appropriate cleaning material, wipe up all dust, dirt and debris from exterior of cabinet, including exterior of Combustion Chamber and Heat Exchanger.

STEP7: Replace Louver Assembly

STEP8: Reconnect Monitor Heater Power Plug to the Wall Outlet.
STEP9: Turn Heater ON

STEP10: Reprogram Heater Microprocessor

STEP11: Select Mode of Operation

CAUTION: If after the completion of recovery procedure, the heater overheats again, something is wrong !

Do not operate heater until problem has been diagnosed and corrected.

3-14 RECOVERY FROM BLOWN FUSE

All electrical components of the Monitor heater are protected against power overloads and electrical malfunctions by two 2-amp fuses and a 10-amp fuse. Should fuse blow, the recovery procedure is outlined below:

STEP1: Turn Monitor OFF

STEP2: Unplug heater

STEP3: Remove louver assembly

STEP4: Remove front cover

NOTE: As the Front Cover of the Monitor 441 is connected to the Printed Circuit Board by Lead Wires, pull the Front Cover to the front side slightly and remove the Connector of the Lead Wires from the Printed Circuit Board, and then, remove the Front Cover.

STEP5: Locate and replace fuse(s)

STEP6: Reattach front cover (In case of the Monitor 441, be sure that the connector is connected to the printed circuit board.)

STEP7: Reattach louver assembly

STEP8: Plug heater power cord into wall outlet

STEP9: Turn Monitor ON

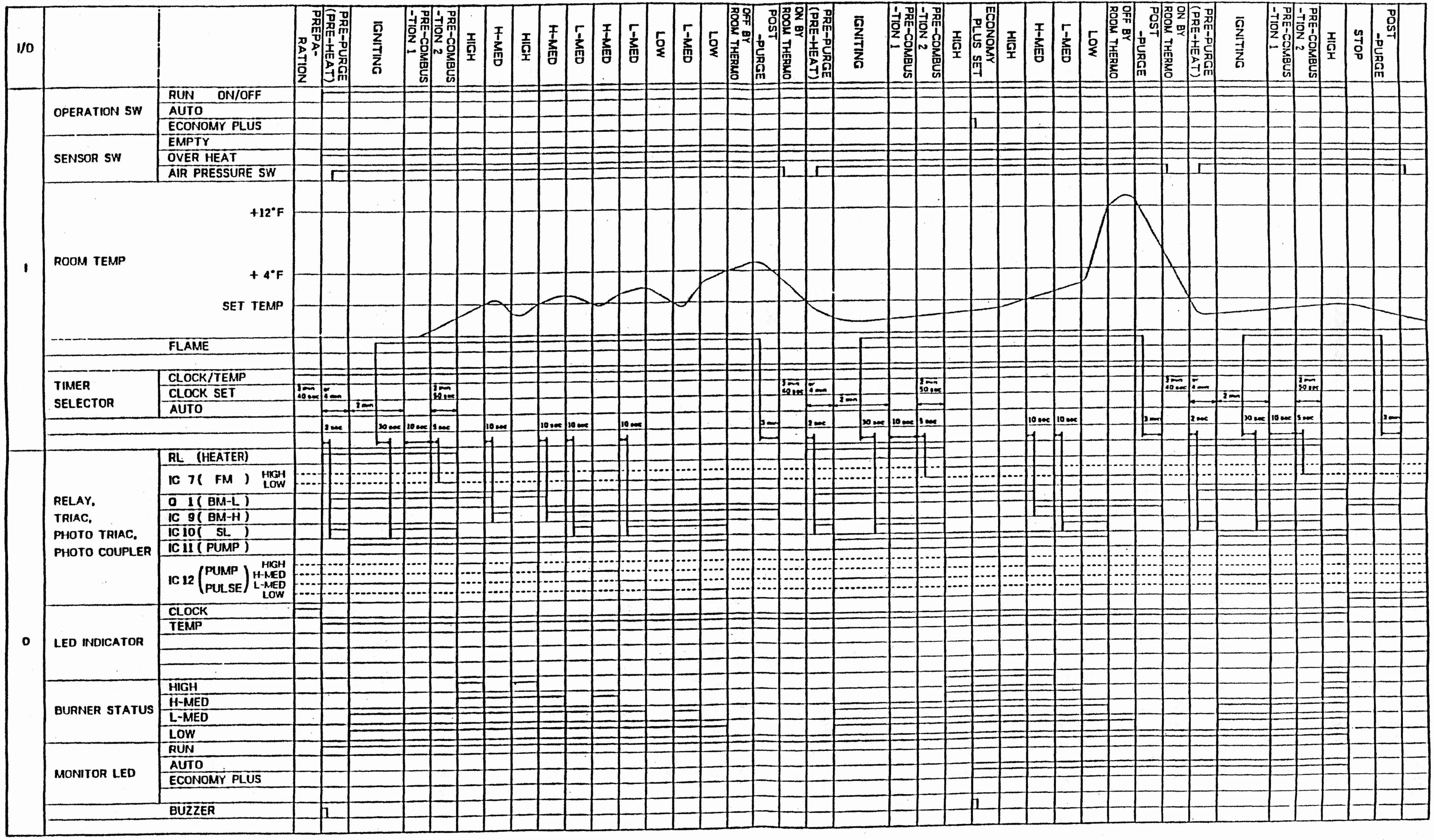
STEP10: Reprogram heater

STEP11: Program Automatic operation cycles (if applicable)

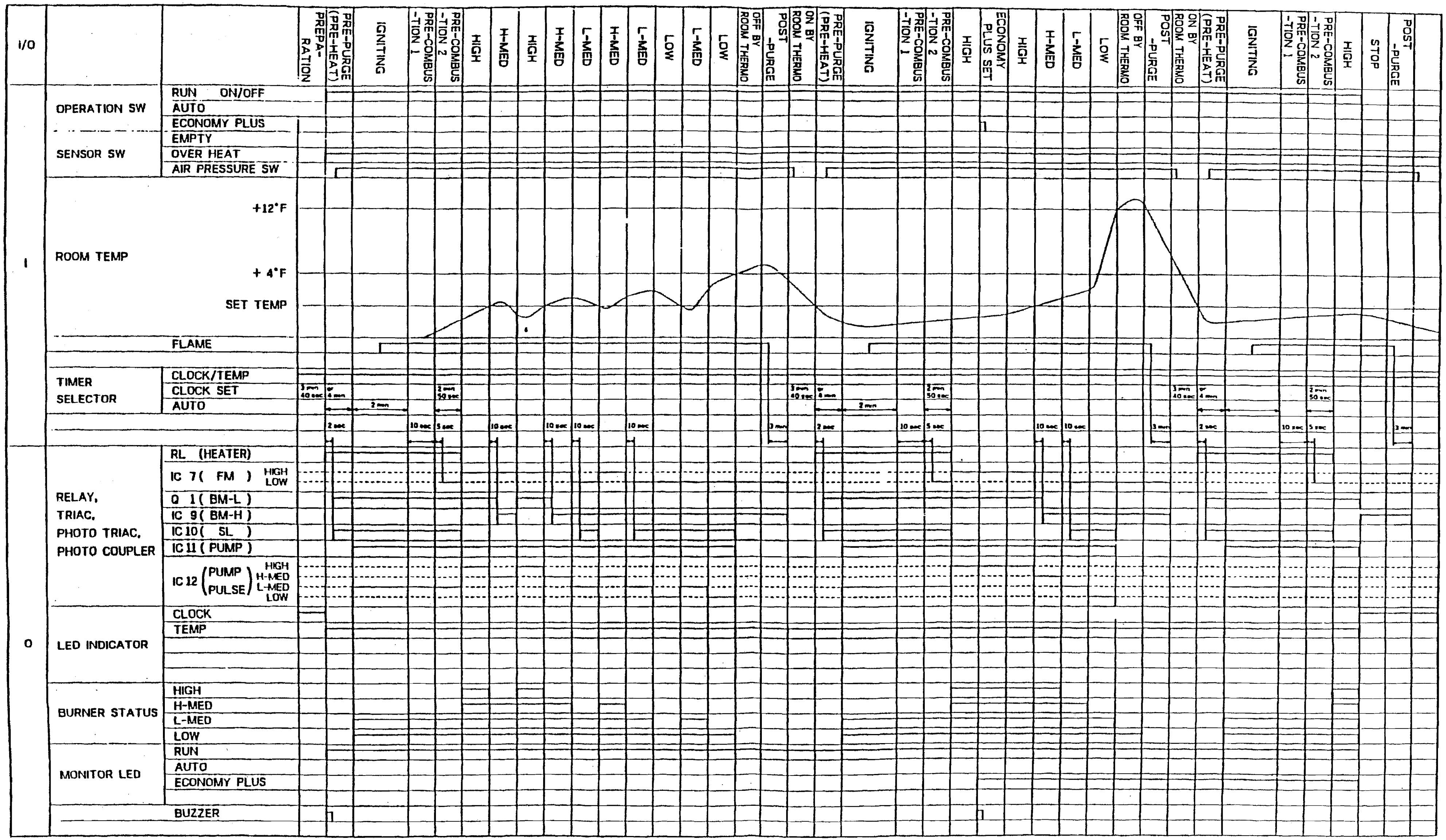
STEP12: Select Automatic operation (if applicable)

3-15 OPERATION CONTROL SYSTEM

M-441 OPERATION TIMING CHART


I/O
PREPA-RATION
PRE-PURGE (PRE-HEAT)
IGNITING
PRE-COMBUS-TION 1
PRE-COMBUS-TION 2
HIGH
H-MED
HIGH
H-MED
L-MED
H-MED
L-MED
LOW
L-MED
LOW
OFF BY ROOM THERMO
POST-PURGE
ON BY ROOM THERMO
PRE-PURGE (PRE-HEAT)
IGNITING
PRE-COMBUS-TION 1
PRE-COMBUS-TION 2
HIGH
ECONOMY PLUS SET
HIGH
H-MED
L-MED
LOW
OFF BY ROOM THERMO
POST-PURGE
ON BY ROOM THERMO
PRE-PURGE (PRE-HEAT)
IGNITING
PRE-COMBUS-TION 1
PRE-COMBUS-TION 2
HIGH
STOP
POST-PURGE
I
OPERATION SW
RUN ON/OFF
AUTO
ECONOMY PLUS
SENSOR SW
EMPTY
OVER HEAT
AIR PRESSURE SW
ROOM TEMP
+12°F
+ 4°F
SET TEMP
FLAME
TIMER SELECTOR
CLOCK/TEMP
CLOCK SET
AUTO
O
RELAY, TRIAC, PHOTO TRIAC, PHOTO COUPLER
RL (HEATER)
IC 7 (FM) HIGH LOW
Q 1 (BM-L)
IC 9 (BM-H)
IC 10 (SL)
IC 11 (PUMP)
IC 12 (PUMP PULSE) HIGH H-MED L-MED LOW
LED INDICATOR
CLOCK
TEMP
BURNER STATUS
HIGH
H-MED
L-MED
LOW
MONITOR LED
RUN
AUTO
ECONOMY PLUS
BUZZER

M-422 OPERATION TIMING CHART


I/O
I
O
PREPA-RATION
PRE-PURGE (PRE-HEAT)
IGNITING
PRE-COMBUS-TION 1
PRE-COMBUS-TION 2
HIGH
H-MED
HIGH
H-MED
L-MED
H-MED
L-MED
LOW
L-MED
LOW
OFF BY ROOM THERMO
POST-PURGE
ON BY ROOM THERMO
PRE-PURGE (PRE-HEAT)
IGNITING
PRE-COMBUS-TION 1
PRE-COMBUS-TION 2
HIGH
ECONOMY PLUS SET
HIGH
H-MED
L-MED
LOW
OFF BY ROOM THERMO
POST-PURGE
ON BY ROOM THERMO
PRE-PURGE (PRE-HEAT)
IGNITING
PRE-COMBUS-TION 1
PRE-COMBUS-TION 2
HIGH
STOP
POST-PURGE
OPERATION SW
RUN ON/OFF
AUTO
ECONOMY PLUS
SENSOR SW
EMPTY
OVER HEAT
AIR PRESSURE SW
ROOM TEMP
+12°F
+ 4°F
SET TEMP
FLAME
TIMER SELECTOR
CLOCK/TEMP
CLOCK SET
AUTO
3 min 40 sec
or 4 min
2 min
2 min 50 sec
2 sec
10 sec
5 sec
3 min
RELAY, TRIAC, PHOTO TRIAC, PHOTO COUPLER
RL (HEATER)
IC 7 (FM) HIGH LOW
Q 1 (BM-L)
IC 9 (BM-H)
IC 10 (SL)
IC 11 (PUMP)
IC 12 (PUMP PULSE) HIGH H-MED L-MED LOW
LED INDICATOR
CLOCK
TEMP
BURNER STATUS
HIGH
H-MED
L-MED
LOW
MONITOR LED
RUN
AUTO
ECONOMY PLUS
BUZZER

4-1 INTRODUCTION

Heater maintenance is divided into two classifications; periodic maintenance is required to maintain the heater in good operating condition; corrective maintenance is necessary to repair a malfunction.

4-2 PERIODIC MAINTENANCE

The Maintenance Schedule provided in Table 4-1 describes the tasks that must be performed periodically in order to sustain the efficiency of the Monito Heating Systems.

At the time of the demonstration or installation, heater maintenance should be discussed with the user; emphasize that a clean heater and proper fuel are the keys to optimum heater operation and performance.

Table 4-1 SUGGESTED MAINTENANCE ACTIVITIES

Activity	Material	Remarks
Check all fuel pipes for leaks and loose connections	3/8" OD copper tubing	Fuel piping must be secure and free of leaks; Replace tubing when necessary.
Inspect exhaust piping for leaks or loose connections		All exhaust pipes must be covered by a cloth insulation cover. If cloth cover shows signs of discoloration at joints, check o-rings.
Check fuel for water and/or other contamination. If the capsule tank is used on the Monitor 422 the capsule tank filter should be checked, cleaned or replaced, as well as the constant level valve strainer.		Fuel color should be crystal clear. if fuel is contaminated, see Corrective Maintenance procedure, paragraph 4-9,
Inspect Fuel Pipe for obstruction		
Inspect electrical wiring for cracks, signs of deterioration, bare wires and/or loose connectors		**WARNING:** **UNPLUG HEATER BEFORE PROCEEDING. HEATER MUST ALSO BE COOL BEFORE STARTING.**
Clean heater	Clean, lint-free cloth and a mild non-abrasive household cleaning agent. USE ONLY NON-PETROLEUM DISTILLATE CLEANERS.	Wipe down exterior of heater cabinet. Vacuum heater interior (if necessary).
Clean Air Circulation Fan (Monthly)		Vacuum fan cage. Wipe fan blades.
Inspect air piping for leaks or loose connections. Inspect rubber Air Hose at rear of heater.		Look for cracks, wear, or signs of deterioration; replace if necessary.
Clean fuel constant level Valve filter. Inspect fusible link Valve input fitting. Clean only if necessary. Verify that heater is level.	Clean Kerosene	Refer to paragraph 4-5. Procedure is described in paragraph 4-6. Check Leveling Guide.
Inspect flue pipe for obstruction or corrosion.		If blocked, clean and vacuum. If corroded badly, replace.

Activity	Material	Remarks
Inspect Combustion Ring, Flame Sensor Rod, Baffle, and Burner Cloth.(Suggested frequency every 3 years).		Clean all carbon deposits. Replace if excessively worn, warped, or cracked. **NOTE:** If any gaskets are torn when Components are removed, the gasket must be replaced.
Clean Combustion Chamber (every 3 years)		Vacuum all carbon deposits from interior of chamber.
Inspect air holes in Burner Pot		Use a small, stiff brush or a short length of soft copper wire to clean any blocked holes. The M422 may need air holes reamed with a torchtip cleaner if partially block on a 5 to 7 year basis.
Clean Igniter		Scrape any carbon deposits from igniter.
Check air piping that interconnect Combustion Blower and Air Pressure Switch.		Replace air piping that is worn, broken or brittle.
Check for carbon build up in fuel inlet going into burn chamber (every year)		Disconnect copper fuel piping from burn chamber and clear fuel inlet line by reaming with a solid piece of wire(such as copper,bailing wire,or coat hanger) which should be able to go in approximately 3" without obstruction. **NOTE:** Removing and retightening burner fuel connection must be done when the burner cools down completely. If it is done when the burner is hot, the welding on the fuel joint may break. Fixing torgue for nut;30~40kg·cm(26~35lb·in)

4-3 INSPECT EXHAUST/AIR PIPING

Verify that all exhaust and air pipes are free of leaks and loose connections, as specified below:

STEP1: Remove Protective Cloth

Remove cloth insulation cover(s) from all exhaust pipes.

STEP2: Inspection of Exhaust/Air Piping

A. Visually inspect both air and exhaust piping for obvious cracks, leaks, or loose connections. Black carbon deposits may be evidence of these leaks, and o-rings may need to be replaced.

B. Be sure that all pipes are installed tightly and securely, especially at joints.

C. Turn heater ON.

D. Carefully apply a small amount of soapy water (with a paint brush) to the surface areas of the air/exhaust piping.

Any leaks that may exist will be readily identified by the appearance of bubbles.

STEP3: Return to Operating Condition

A. Turn heater OFF.

B. Dry all pipes with paper towels.

C. Repair any leaks that have been found (if necessary, replace the tubing).

D. Replace cloth insulation covers.

4-4 VERIFY IGNITER OPERATION

Visually inspect Igniter Operation

WARNING:

HEATER IS OPERATIONAL DURING THIS INSPECTION. AVOID DIRECT CONTACT WITH ANY HEATED OR ELECTRICAL COMPONENT.

STEP1: Prepare for Inspection

Remove Louver Assembly.

STEP2: Visual Inspection

A. Turn heater ON.

B. Look (downward) through window on the CombustionChamber. Verity that igniter is glowing.

If igniter does not glow, something is wrong. Refer to the Troubleshooting Chart in Section 6 of this Service Manual to diagnose the problem.

C. An alternate inspection is to feel the igniter cover after the unit has been in the ignition stage for about 5 minutes. It should be warm.

CAUTION: If igniter is broken,do not operate the "ON/OFF" switch button repeatedly.

STEP3: Reassembly of Heater

Turn the heater OFF and replace the Louver Assembly.

4-5 CLEAN FUEL CONSTANT LEVEL VALVE FILTER

Contaminants are trapped by the filter to prevent them from clogging the Fuel Constant Level Valve.

The filter, itself has a great number of small pores. Whenever a filter is torn or disfigured (enlarged pores), it should immediately be replaced.

Inspect and clean the filter as indicated by the procedure below:

WARNING

CLOSE FUSIBLE LINK VALVE ON M-422 OR CLOSE SHUT-OFF VALVE OF THE EXTERNAL FUEL TANK ON M-441 TO AVOID DRAINING ALL FUEL FROM TANKS.

NOTE: Power should be OFF during the performance of this procedure.

STEP1: Disassembly

A. Using a phillips head screwdriver, unscrew the screws holding the rounded diamond-shaped cover plate at the bottom of the Fuel Constant Level Valve. Remove the cover plate.

NOTE: Position a six inch U shaped piece of metal or cardboard under strainer cover to drain fuel into a pan.

B. Carefully remove the rubber gasket which is located behind the cover plate.

STEP2: Inspection and Cleaning

A. Pull the filter straight out of the fuel reservoir.

B. If the filter is dirty (but undamaged), rinse the filter in fresh, clean kerosene to remove all particles. Replace damaged filters.

C. To drain off upper portion of fuel constant level valve, back out phillips head screw which is located slightly above and to the left of filter cover plate. (See Fig4-1)

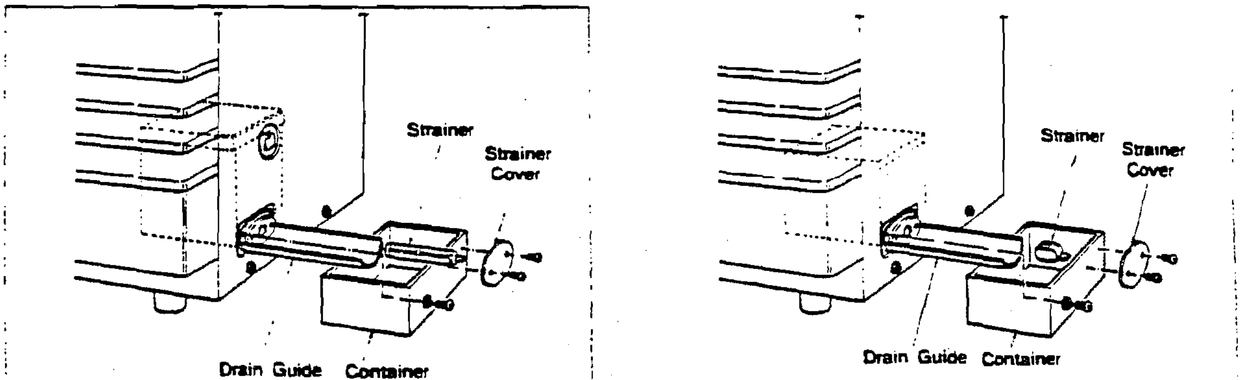
D. If upper portion drain is dirty or containing water, then remove pump and inspect and clean its screen.

STEP3: Reassembly

A. Push the (new or cleaned) filter back into the bottom of the fuel reservoir.

B. Replace both the rubber gasket and the cover plate. (Take care to properly align the screw holes in the gasket and cover plate).

C. Wipe up any spilled fuel.



M-441 M-422

Figure 4-1 CLEAN FUEL CONSTANT LEVEL VALVE

4-6 CLEANING FUSIBLE LINK VALVE INTAKE FITTING ON M-422

At periodic intervals, the fitting on the Fusible Link Valve should be cleaned to prevent any accumulation of foreign materials from clogging the inlet. This is accomplished as follows:

WARNING

UNPLUG THE HEATER. POWER TO THE HEATER SHOULD BE OFF DURING THE PERFORMANCE OF THIS PROCEDURE.

STEP1: Close off Fuel Supply

A. Shut off fuel at the Storage Tank or remove fuel from the fuel sump tank with siphon and syringe if using the capsule fuel tank.

B. Manually turn handle to close Fusible Link Valve.

NOTE: Place paper towels underneath the Fusible Link Valve to catch any spilled fuel.

STEP2: Clean Valve

A. Loosen hex nut on Fusible Link Valve inlet fitting at rear of the heater. Disconnect the copper tubing which delivers the fuel from the storage or the fuel sump tank.

B. Using a small, straight piece of wire carefully and slowly ream-out the inlet fitting on the Fusible Link Valve.

Avoid scratching the inside wall of the fitting.

With a cotton swab, wipe the interior area of the inlet fitting.

STEP3: Reconnect Fuel Line

A. Reconnect the copper tubing to the intake fitting and tighten the hex nut.

B. Turn ON fuel at Fusible Link Valve and at storage tank or fuel sump tank.

C. Check for leaks.

4-7 CORRECTIVE MAINTENANCE

The two procedures below are remedies for very generalized types of operating difficulties.

4-8 REPLACEMENT OF FUSES

A short circuit or similar electrical malfunction could cause the fuse to blow. Troubleshoot the cause of the blown fuse.

Replace the fuse as follows:

WARNING

DO NOT REPLACE FUSE WHILE POWER IS ON.

STEP1: Removal of Fuse

A. Unplug heater. Remove Louver Assembly and Front Cover.

B. Remove the fuse from fuseholder on the Printed Circuit Board.

STEP2: Installation of New Fuse

A. Install a new fuse into the fuseholder. The fuse must be a 250-V, 2 amp or a 250-V, 10 amp type as marked on the printed circuit board.
Do not use oversized fuses.

B. Replace the Front Cover and the Louver Assembly and plug the heater into the wall outlet.

IMPORTRNT: Whenever the heater is unplugged, the Microprocessor must be reprogrammed when power is restored.

4-9 FUEL CONTAMINATION

Fuel contamination is often difficult to diagnose, even though it will adversely affect heater operation and performance. The best course of action to take when fuel contamination is suspected is to examine all of the system's fuel filters, beginning with the fuel storage tank. If a Monitor Kerosene Lifter is part of the fueling system, examine and clean that unit's filter, as well as the filter located in the Fuel Constant Level Valve. When it has been determined that water or some other contaminants have infiltrated the fuel, the following action must be taken:

WARNING

BEFORE PROCEEDING FURTHER, UNPLUG THE HEATER.

STEP1: Remove Contamination

A. Shut OFF the fuel supply at the storage tank or at the Fusible Link Valve.

B. Drain off the contaminants from the fuel storage tank or the fuel sump tank(M-422). Fill with fresh, clean fuel.

STEP2: Clean the Heater

A. Clean fuel constant level valve filter and filter compartment.

B. Remove the Louver Assembly and Solenoid Pump on the constant level valve. Clean the Solenoid Pump filter.

STEP3: Reinstall Cleaned Components

A. Replace the components correctly and install new gasket.

B. Turn on the fuel at the storage tank and at the fusible link valve, and apply power to the heater.

If problem still exists and contaminated fuel is suspected it can be checked by

A. Shutting off the fuel supply at the storage tank and at the fusible link valve.

B. Drain off fuel at constant level valve.

C. Disconnect fuel line at back of heater and hook up a 5 gallon quick tank with proven good fuel.

D. Test run heater to see if problem clears up with use of new fuel.

5-1 INTRODUCTION

Servicing is required when the Monitor Heater is not running at proper efficiency. This section covers possible causes and corrective procedures for efficiency loses.

Signs of improper heater efficiency and performance would be:

— Yellowish lazy flame
— Smoke from flue pipe exhaust
— Heavy soot and carbon build up in combustion chamber
— Lowered heat output.

5-2 MEASUREMENT OF FUEL FLOW RATE

Fuel flow rates are preset and sealed. These rates should not and we recommend they do not be readjusted.

5-3 REMOVAL OF WATER DEPOSITS AND CONTAMINANTS FROM FUEL CONSTANT LEVEL VALVE AND FUEL LINES

NOTE: Disconnect the Monitor from power supply (unplug) before proceeding.

1. Use a syphon pump and a syringe to drain off any fuel in the fuel sump (in case of capsule tank use on the Monitor 422).
2. If using separate tank on the Monitor 422 shut off fusible link valve. On the Monitor 441 shut off valve of separate tank.
3. Bend a piece of sheet metal or cardboard into a U shape and place it under the fuel constant level valve strainer cover to drain bad fuel into a 1-2 liter pan. (Figure 4-1)
   - A. Remove strainer cover and drain.
   - B. With strainer cover removed, inspect, clean and/or replace strainer if damaged.
   - C. Remove drain port screw and drain.
   - D. Replace strainer, cover and screw.
   - E. Open fusible link valve or shut-off valve to refill system with fresh crystal clear kerosene.
   - F. Repeat steps 1-3 until all contaminated fuel is drained off.
4. Remove fuel feed pipe from burner pot and solenoid pump, and drain fuel into pan.
5. Once lines are clear, reconnect fuel feed pipe, turn operation switch ON and start a test run.

NOTE: Removing and retightening burner fuel connection must be done when a burner cools down completely. If it is done when a burner is hot. the welding on the fuel joint may break. Fixing Torque for nut:30 −40kg · cm(26−35lb.in).

5-4 CLEANING THE BURN CHAMBER & BURNER POT

Under normal running conditions, soot will not deposit in great quantities inside the burner, and a light covering of soot will not affect the performance of the unit thus it need not be cleaned. However, if heavy soot built up does occur the unit should be opened and cleaned.

The burner is assembled using gaskets to maintain its air tightness. If these gaskets leak, the extra air can cause a serious soot problem and or exhaust gases to escape into the area being heated.

NOTE: If any gaskets are torn when components are removed, replace. Disconnect power supply to unit.

If cleaning is necessary, use the following method·

1. On the Monitor 422
   - A. Remove louver assembly.
   - B. Remove front cover.
   - C. Remove top cover and lead wire connectors.
   - D. Remove front and top heat shields that cover the burn chamber and their lead connectors.
   - E. Remove fuel piping from burn chamber.
   - F. Remove igniter.
   - G. Remove flame detective rod lead from PCB (DO NOT REMOVE FROM BURN CHAMBER).
   - H. Remove screw at top of burner cap which attached it to cabinet. Remove screw at back of cabinet from exhaust duct and remove the 4 screws holding the burn chamber to base.
   - I. Rock chamber back and forth lightly, raise about 1/2" and remove burn chamber and heat exchanger, as one assembly from unit.
   - J. Set chamber upside down and remove the 4 screws which secure the burner pot to the burn chamber. Pull the burner pot up and out.
2. On the Monitor 441
   - A. Remove louver assembly.
   - B. Remove front cover and wire connectors.
   - C. Remove top cover.
   - D. Remove heat shield that covers combustion chamber.
   - E. Remove service panel.
   - F. Remove Flame detector rod.

   For a more thorough cleaning, use the same procedure as for the M422 above.

3. Turn counter-clockwise to remove combustion ring. If ring does not turn, pull up slightly to loosen retaining clips.
4. Use wire brush to clean inside of combustion chamber.
   Vacuum and wipe clean with a waste cloth.
5. If tar is present on the burner bottom, remove the tar by using a flat-bladed screw driver or wire brush,then clean the area by using a vacuum cleaner etc.

NOTE: Make sure all air inlet openings are clear.

6. When cleaning the inside of the burner pot, remove the igniter and change the burner cloth by the following procebure.

7. On the Monitor 422
   A. Apply glue(P/No8217) on the burner bottom as shown in Figure5-1.

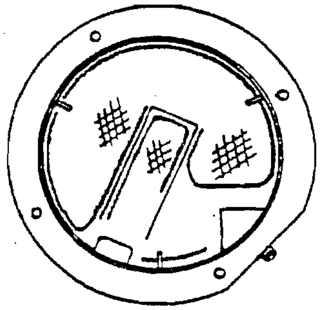


Figure 5-1

   B. Put the burner cloth on the burner bottom, afterwards press and straighten out the burner cloth so that it is glued flat and even on the burner bottom.

8. On the Monitor 441
   A. Apply glue arround the burner cloth as shown in Figure 5-2.

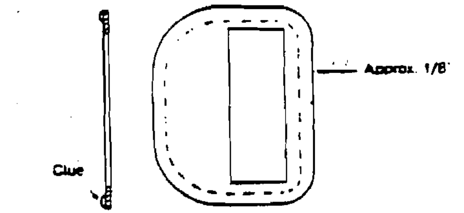


Figure 5-2

   B. As shown in Figure 5-3 and 5-4, insert the Burner Cloth narrow between the Nozzle Collar and the Igniter Shield, then push the Burner Cloth, using your fingers or a screw driver, so that it slips in under the Nozzle Collar. Afrerwards press and straighten out the Burner cloth so that it is glued flat and even on the Burner bottom.

NOTE: In some cases, pulling out the Fuel Nozzle and Collar may make this procedure easier. An easy out can be inserted into nozzle to help break loose and remove it.

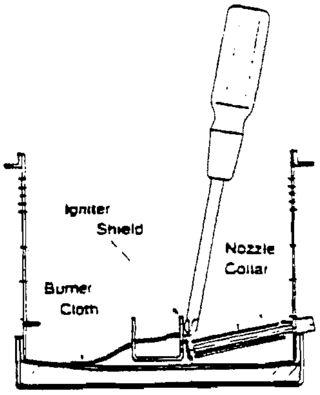


Figure 5-3

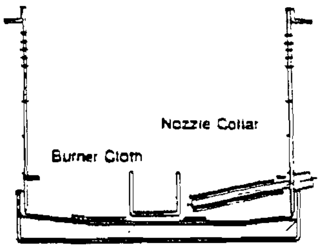


Figure 5-4

   C. Apply glue at all 4 corners of Burner Cloth as Shown in Figure 5-5.

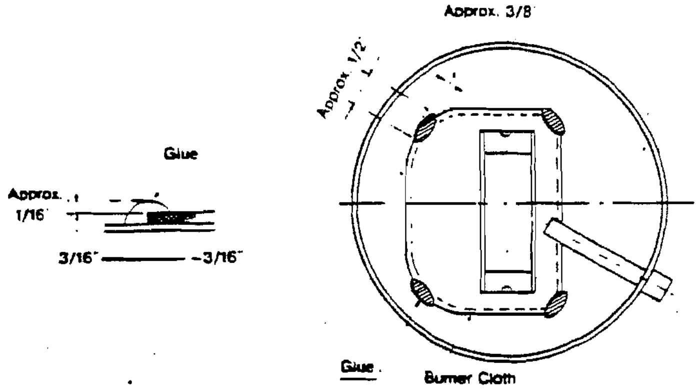


Figure 5-5

NOTE: The Burner Cloth is not symmetrical in shape, therefore make sure to place it in the correct position so that the wider side of the cloth is at left side of the Igniter Shield as shown in Figure 5-5.

9. Combustion ring may deform and deteriorate after several years use and should be cleaned and inspected before reinstallation. If combustion ring is warped, has cracked or is deteriorating excessively it should be replaced.
10. When reassembling the unit check that combustion ring is positioned with the correct side up and is sitting squarely on all three support screws(M-422) or pins(M-441) inside the burner pot.
11. Reassemble by reversing the procedure followed during disassembly.

NOTE: Use of the economy plus feature can minimize service calls and extend component life.

NOTE: Make sure the position of flame detector rod is centered between combustion ring and burner pot before reassembling.(See Figure 5-6)

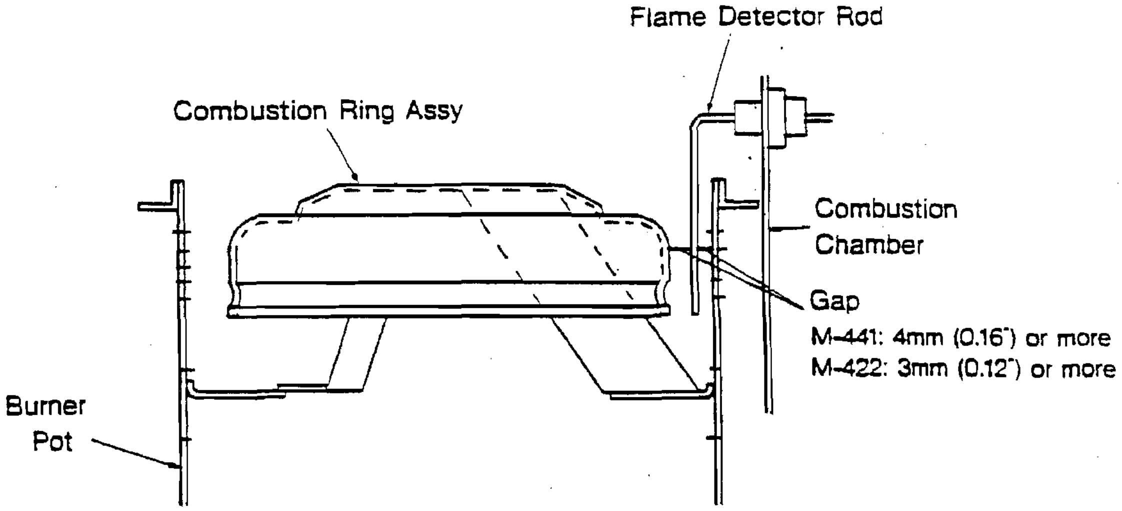

Flame Detector Rod
Combustion Ring Assy
Combustion Chamber
Gap
M-441: 4mm (0.16") or more
M-422: 3mm (0.12") or more
Burner Pot

Figure 5-6

For minor adjustments of flame detector rod without disassembling any components:

1. Loosen the two retaining screws about half to one full turn.
2. Tightening down on the top screw first will cock the rod outward away from the combustion ring. Tightening the bottom screw first will cock the rod inward towards the combustion ring.

5-5 CLEANING THE FUEL INLET

When cleaning the combustion chamber and the burner pot, the fuel inlet nozzle should also be cleaned. This can be done as follows:

1. Disconnect copper fuel line at burn chamber.
2. Push a piece of wire (about the same size as the I.D. of fuel inlet pipe) into the fuel inlet nozzle.
3. If obstruction is felt twist wire back and forth (to brake up soot and carbon) so that wire ultimately penetrates igniter shield.
   On M-422, also check air holes surrounding fuel inlet for blockage and clear if necessary.

Monitor 422/441 Resistance values

COMPONENT	APPROX. M-422	OHMS M-441
Igniter (connector B/B)	16.8	12.7
Power Transformer—Primary (AC 120V)	125	125
Power Transformer—Secondary (AC 12V)	1.6	1.6
Power Transformer—Secondary (AC 120V)	647	647
Damper Solenoid (connector I/I)	4,600	4,600
Resistor (connector G/G)	68	91
Circulation Fan (M-422:RD & BK, M-441:WH & BK)	235	115
Circulation Fan (M-422:BK & YL, M-441:BK & BL)	247.5	258.5
Combustion Blower (M-422:BK & BK, M-441:WH & GR)	22	78
Combustion Blower (M-441:GR & OR)	–	92
Thermistor (connector Q/Q, at 77° F)	10,000	10,000
Fuse 2A (read with fuse out)	0.1	0.1
Fuse 10A (read with fuse out)	0.01	0.01
Solenoid Pump (coil)	565	565

WARNING:

DISCONNECT HEATER FROM POWER SOURCE BEFORE MAKING ANY RESISTANCE TESTS.

Monitor 22 41 Resistance values

COMPONENT	APPROX.	OHMS
	M-22	M-41
Igniter (connector B B)	16.8	12.7
Power Transformer – Primary (connector H H)	97	97
Power Transformer – Secondary (connector L L)	824	824
Power Transformer – Secondary (connector M M)	1.3	1.3
Damper Solenoid (connector I I)	4,600	4,600
Resistor (connector G G)	68	91
Circulation Fan (M-41:WH & BK, M-22:RD & BK)	310	120
Circulation Fan (M-41:WH & GR, M-22:RD & YL)	365	190
Circulation Fan (M-41:BL & BK, M-22:GR & BK)	270	260
Circulation Fan (M-41:BL & GR, M-22:GR & YL)	210	200
Combustion Blower (M-41:WH & GR, M-22:BK & BK)	22	78
Combustion Blower (M-41:GR & OR)	—	92
Thermistor (connector Q Q, at 77 F)	10,000	10,000
Fuse 2A (read with fuse out)	0.1	0.1
Fuse 10A (read with fuse out)	0.01	0.01
Solenoid Pump (coil)	688	695

WARNING:

DISCONNECT HEATER FROM POWER SOURCE BEFORE MAKING ANY RESISTANCE TESTS.

Monitor 422/441 Component Voltage Readings

COMPONENT	READING TAKEN AT	AC	DC
Thermistor	Q on PCB Sensor disconnected		5
Thermistor	Q on PCB Sensor connected		1.5-3.2
Air Pressure Switch/ Overheat Protector Closed	Connector J	110	
Air Pressure Switch/ Overheat Protector Open	Connector J	0	
Damper Solenoid	I on PCB		105
Solenoid Pump	K on PCB		pulse*
Circulation Fan High Speed	RD to BK(M-422) WH to BK(M-441)	110 110	
Circulation Fan Low Speed	RD to BK(M-422) WH to BK(M-441)	93 91	
Igniter	B on PCB	110	
Power Transformer (primary side)	AC 120V	110	
Power Transformer (secondary side)	AC 120V AC 12V	120 12	
Combustion Blower High Speed	F on PCB	110	
Combustion Blower Low Speed	F on PCB (Q1 is OFF)	92(M-422) 88(M-441)	
Resistor	G on PCB	18(M-422) 22(M-441)	

*Pulse can only be measured with a high impedance digital volt meter.

Monitor 22/41 Component Voltage Readings

COMPONENT	READING TAKEN AT	AC	DC
Thermistor	Q on PCB Sensor disconnected		5
Thermistor	Q on PCB Sensor connected		1.6-3.3
Air Pressure Switch Overheat Protector Closed	Connector J	110	
Air Pressure Switch Overheat Protector Open	Connector J	0	
Damper Solenoid	I on PCB		105
Solenoid Pump	K on PCB		105
Circulation Fan High Speed	GR to BK BK to RD (M-21)	110	
	BL to BK BK to WH (M-40)	110	
Circulation Fan Low Speed	YL to RD GR to YL (M-21)	110	
	GR to WH BL to GR (M-40)	110	
Igniter	B on PCB	110	
Power Transformer (primary side)	H on PCB	110	
Power Transformer (secondary side)	Connector L	120	
	Connector M		11
Combustion Blower High Speed	F on PCB	110	
Combustion Blower Low Speed	F on PCB (RL3 is OFF)	92(M-22) 88(M-41)	
Resistor	G on PCB	18(M-22) 22(M-41)	

TEST POINT VOLTAGE

Operation Mode Test Point	Preparation	Pre-purge Pre-heat	Igniting low med 2 min.	Pre-burning 1 (C.F.M:Off)	Pre-burning 2 (C.F.M:Low)
TP 2	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%
TP 3	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%
TP 4	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V
TP 5	pulse	pulse	pulse	pulse	pulse
TP 6	OV	OV	Infinitly variable	1.2V min.	1.2V min.
TP 7	pulse at plugin	5V	5V	5V	5V

Operation Mode Test point	High	Medium-High	Medium-Low	Low	OFF	Post-purge	Waiting until programmed time comes on
TP 2	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%
TP 3	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%
TP 4	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V	1.5 ~ 3.2V
TP 5	pulse	pulse	pulse	pulse	pulse	pulse	pulse
TP 6	1.2V min.	1.2V min.	1.2V min.	1.2V min.	OV	Infinitly variable	OV
TP 7	5V	5V	5V	5V	5V	5V	5V

TEST POINT VOLTAGE

Operation Mode / Test Point	Preparation	Pre-purge Pre-heat	Igniting low med 2 min.	Pre-burning 1 1.5 min. (C.F.M:Off)	Pre-burning 2 1.5 min. (C.F.M:Low)
TP 3	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%
TP 4	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%
TP 5	3.9V	3.9V	3.9V	3.9V	3.9V
TP 6	pulse	pulse	pulse	pulse	pulse
TP 7	0V	0V	infinitly variable	1.2V min.	1.2V min.
TP 8	pulse at plugin	5V	5V	5V	5V

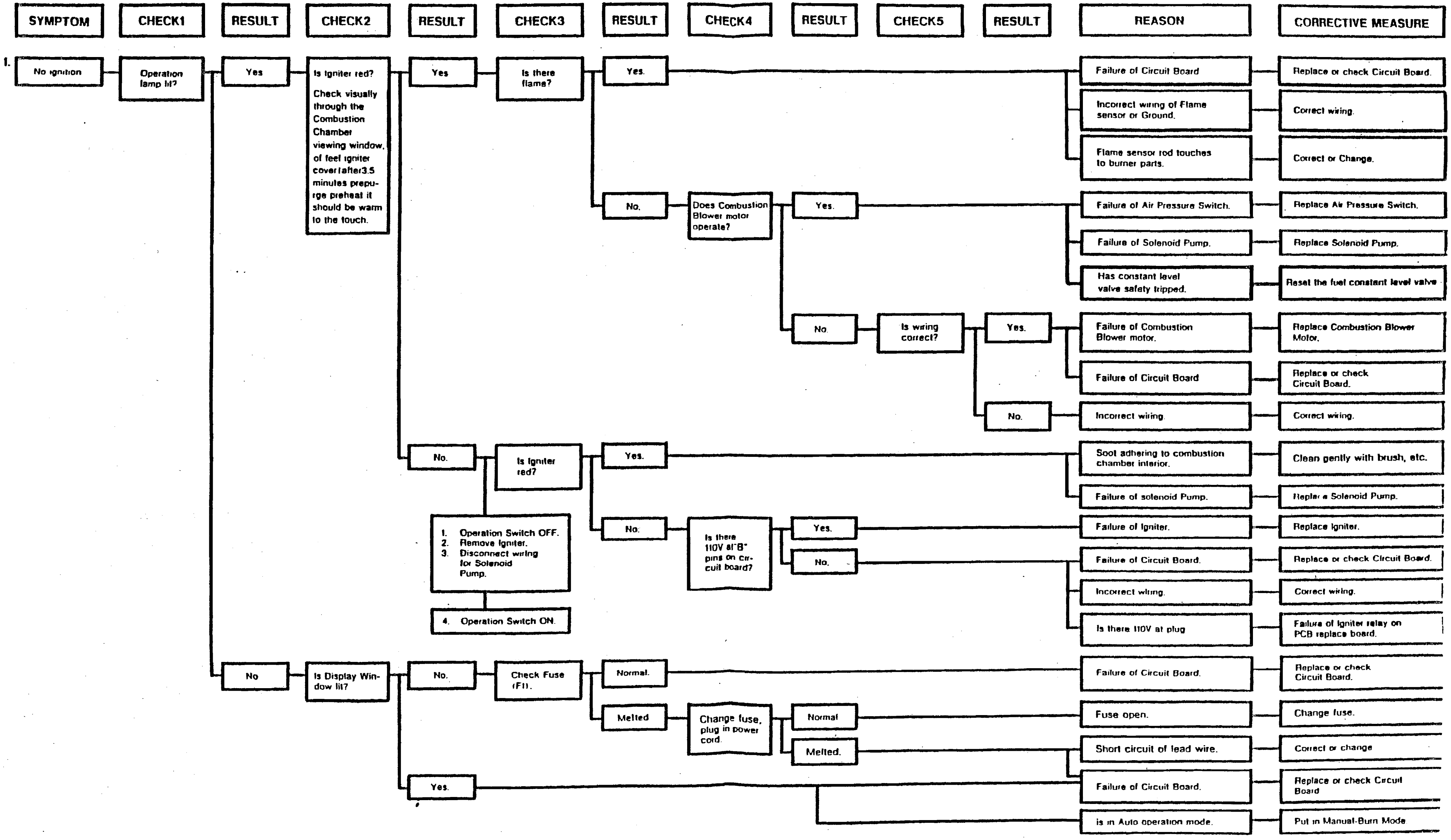
Operation Mode / Test point	High	Medium-High	Medium-Low	Low	OFF	Post-purge	Waiting until programmed time comes on
TP 3	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%	12V ± 30%
TP 4	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%
TP 5	3.9V	3.9V	3.9V	3.9V	3.9V	3.9V	3.9V
TP 6	pulse	pulse	pulse	pulse	pulse	pulse	pulse
TP 7	1.2V min.	1.2V min.	1.2V min.	1.2V min.	0V	infinitly variable	0V
TP 8	5V	5V	5V	5V	5V	5V	5V

INDICATION OF FAILURE MODE

Digital Display	The Reason of Indication	Trouble Point
E01	At pre-purge, Flame rod is sensing flame when there should be none.	Flame sensing circuit, grounded flame rod or pinched wire.
E05	After power on, power supply to the micro-processer timing circuit is incorrect.	Timer clock circuit bad or power source to unit above or below acceptable levels.
E06	At starting of operation, the circuit to drive Relay RL6 of Solenoid Pump is malfunctioning.	Solenoid Pump control circuit has a malfunction.
E12	When unit is shut off either manually or automatically, flame rod does not detect flame out within 300 seconds.	Driving circuit of RL6 or excess fuel in burner pot.

GENERAL CHECKS

Is power available in wall outlet?
Is power Plug inserted in wall outlet?
Has there been a power interruption? (Display window shows 88.88.)
Has Circulation Fan stopped?
Is fuel in tank? Tank valve open?
Has Fuel Constant Level Valve Set Lever raised and lowered?
Is Operation Switch on?
Is operation mode on Manual?
Is set temperature in High position?
Is Fusible Link Valve "open"?



SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
1.
No ignition
Operation lamp lit?
Yes
Is Igniter red?
Check visually through the Combustion Chamber viewing window, or feel igniter cover (after 3.5 minutes prepurge preheat it should be warm to the touch.
Yes
Is there flame?
Yes.
Failure of Circuit Board
Replace or check Circuit Board.
Incorrect wiring of Flame sensor or Ground.
Correct wiring.
Flame sensor rod touches to burner parts.
Correct or Change.
No.
Does Combustion Blower motor operate?
Yes.
Failure of Air Pressure Switch.
Replace Air Pressure Switch.
Failure of Solenoid Pump.
Replace Solenoid Pump.
Has constant level valve safety tripped.
Reset the fuel constant level valve
No.
Is wiring correct?
Yes.
Failure of Combustion Blower motor.
Replace Combustion Blower Motor.
Failure of Circuit Board
Replace or check Circuit Board.
No.
Incorrect wiring.
Correct wiring.
No.
Is Igniter red?
1. Operation Switch OFF.
2. Remove Igniter.
3. Disconnect wiring for Solenoid Pump.
4. Operation Switch ON.
Yes.
Soot adhering to combustion chamber interior.
Clean gently with brush, etc.
Failure of solenoid Pump.
Replace Solenoid Pump.
No.
Is there 110V at "B" pins on circuit board?
Yes.
Failure of Igniter.
Replace Igniter.
No.
Failure of Circuit Board.
Replace or check Circuit Board.
Incorrect wiring.
Correct wiring.
Is there 110V at plug
Failure of Igniter relay on PCB replace board.
No
Is Display Window lit?
No.
Check Fuse (F1).
Normal.
Failure of Circuit Board.
Replace or check Circuit Board.
Melted
Change fuse, plug in power cord.
Normal
Fuse open.
Change fuse.
Melted.
Short circuit of lead wire.
Correct or change
Failure of Circuit Board.
Replace or check Circuit Board
Yes.
Is in Auto operation mode.
Put in Manual-Burn Mode

SYMPTOM	CHECK1	RESULT	CHECK2	RESULT	CHECK3	RESULT	CHECK4	RESULT	CHECK5	RESULT	REASON	CORRECTIVE MEASURE
1. Change of burn mode (High←→Low) is inproper. Connect 10KΩ resistor at [illegible] pins, and then, set temperature from Low to High.	Is temperature display normal?	Yes.	Is solenoid pump able to change fuel flow rate?	No							Failure of microprocessor (IC1).	
											Failure of photo coupler(IC12).	
											Failure of TR array (IC6).	
											Failure of solenoid pump.	Replace solenoid pump.
				Yes	Is circulation fan motor able to change speed?	No					Failure of microprocessor (IC1).	
											Failure of photo triac (IC7).	
											Failure of TR array (IC6).	
											Failure of circulation fan motor.	Replace circulation fan motor.
						Yes.					Failure of microprocessor (IC1).	
											Failure of TR array (IC6).	
											Failure of photo triac (IC8,9).	
											Failure of triac (Q1).	
											Failure of resistor (R1, R51, R52).	
											Failure of capacitor (C2).	
											Failure of combustion blower.	Replace combustion blower.
											Failure of resistor for combustion blower.	
											Failure of damper solenoid.	Replace damper solenoid.
		No.	Is there approx. 2.8V at TP47	No.							Failure of resistor (R12, R13).	
											Failure of capacitor (C11).	
				Yes.							Failure of microprocessor (IC1).	

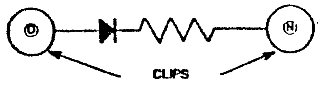
SYMPTOM	CHECK1	RESULT	CHECK2	RESULT	CHECK3	RESULT	CHECK4	RESULT	CHECK5	RESULT	REASON	CORRECTIVE MEASURE
3. Flame failure.	Is there 1.2Vdc at IC3([illegible] pin)?	No.									Failure of resistor (R18～R21, R25)	
		Yes.	Is there more than 1.3Vdc at TP6 ?	No.							Failure of transformer.	Replace transformer.
											Failure of capacitor (IC14～IC16).	
											Failure of resistor (R10, R22～R24).	
				Yes.	Is there OV at IC2 (⑬ pin)?	Yes.					Failure of comparator (IC3).	
						No.	Is there 0.2Vdc or less at Q7.	No.			Failure of resistor (R27).	
											Failure of diode (D19).	
											Failure of capacitor (C29).	
											Failure of transistor(Q7).	
								Yes.			Failure of microprocessor(IC1).	
											Failure of resistor (R33, R34).	
											Failure of wiring for flame sensor and ground.	Correct wiring.
											Incorrect installation of flame sensor rod.	Correct installation.

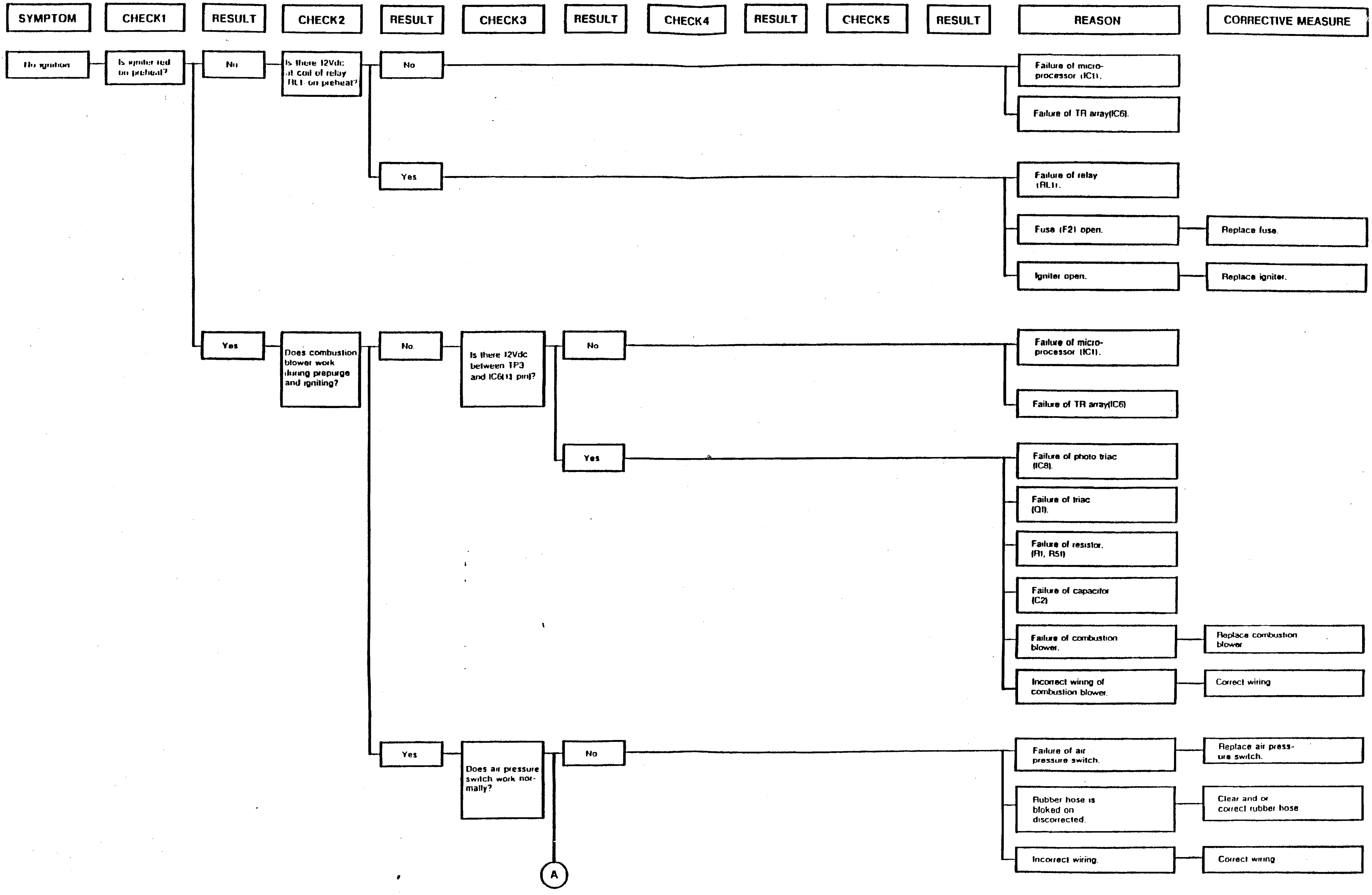
FLAME ROD BYPASS CIRCUIT

For testing purposes - A flame detector rod bypass circuit can be made up, consisting of 2 insulated alligator clips, 2-6" pieces of insulated copper wire, 1-1/4" watt 400 volt diode, and 1-1/4" watt 100k OHM resistor. These components are to be soldered together in sequence as shown in diagram below (note component sequence and polarity).

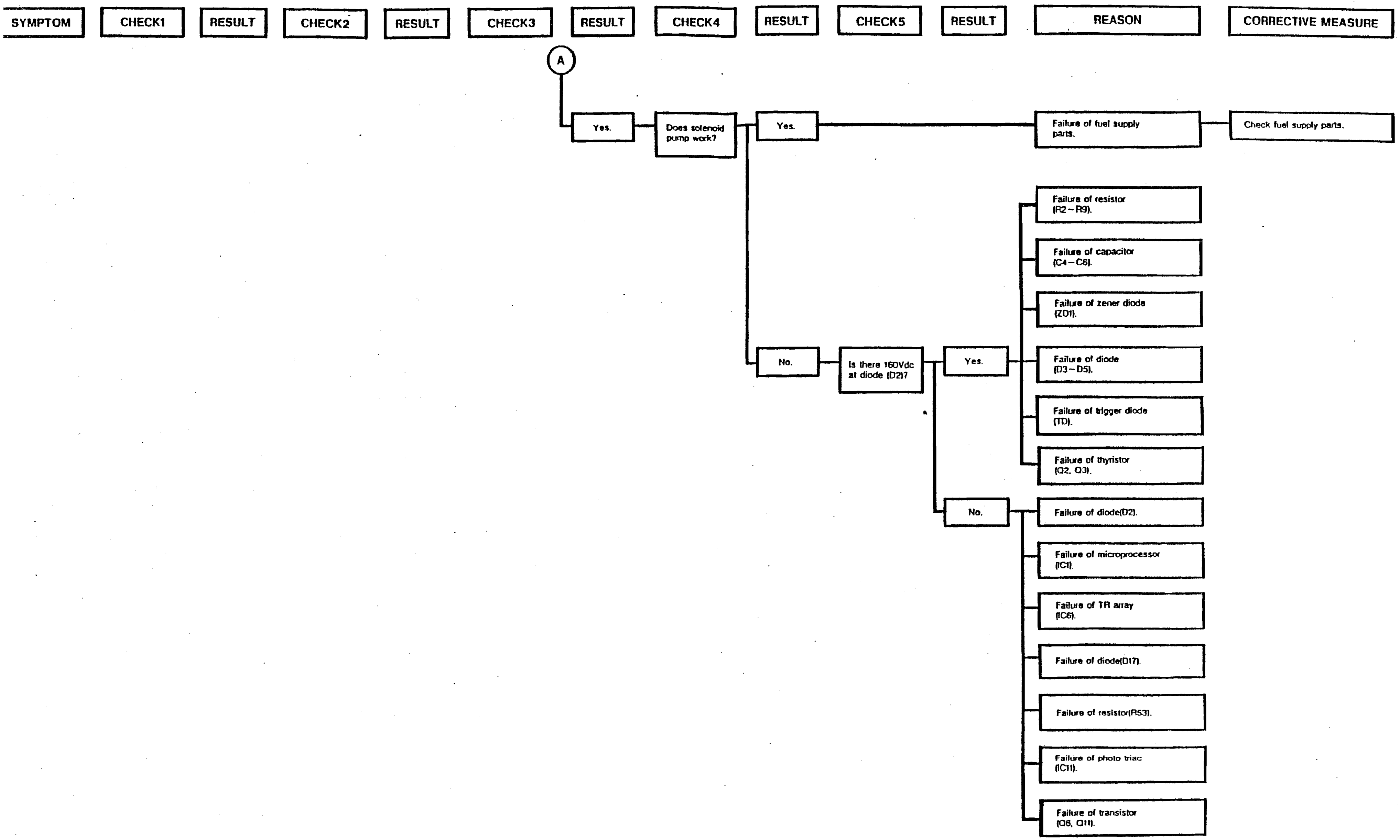
Once the bypass circuit is made the unit is turned on, immediately after the prepurge preheat cycle; when mode light comes on, the O and N pins are disconnected off the PCB and replaced with the bypass circuit. The unit should then continue functioning as though it had a good flame inside the burn chamber and service tests such as fuel flow can be checked.

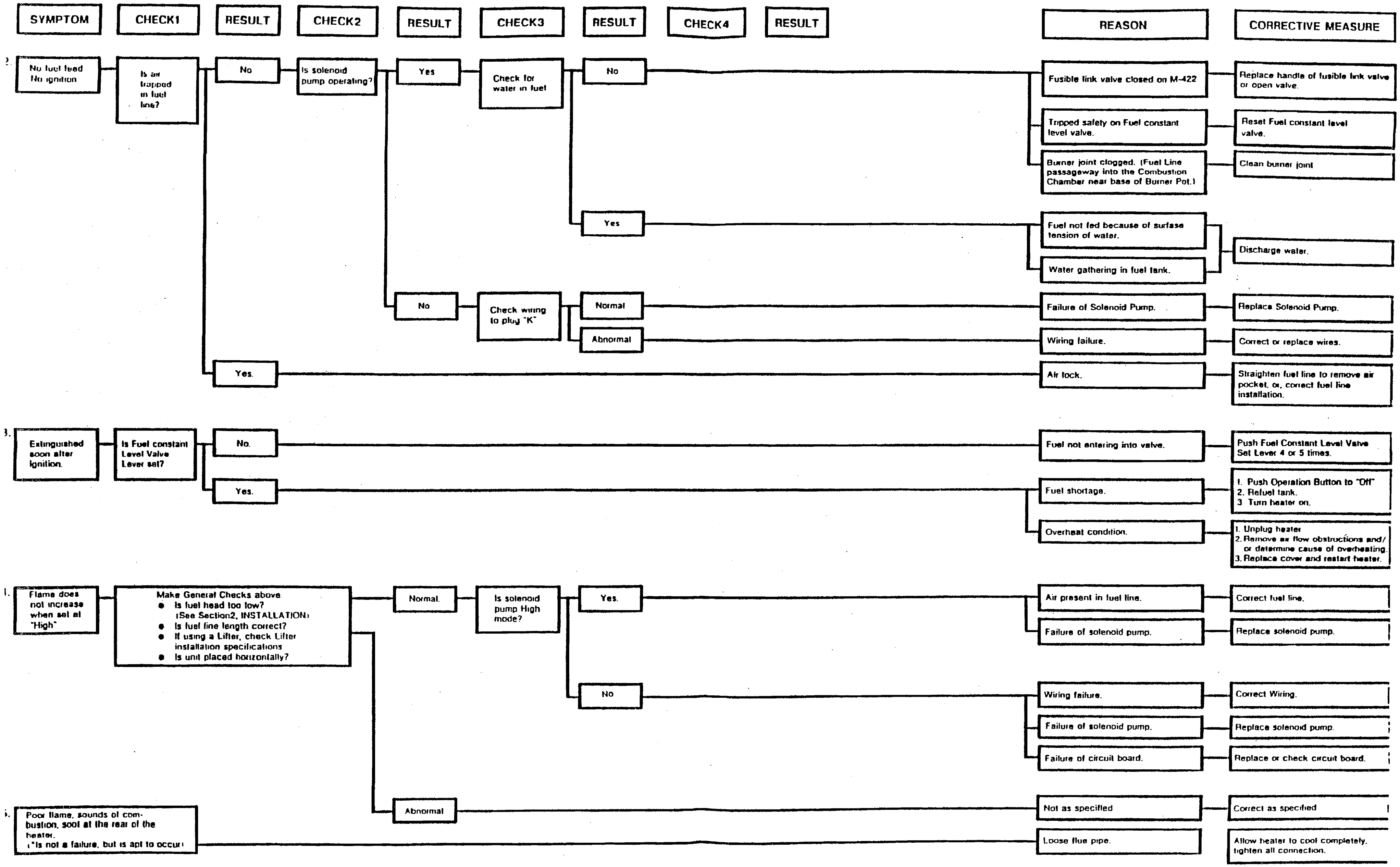
(Note-WARNING, after all tests are completed, replace original flame rod wires as it is a vital safety feature.)

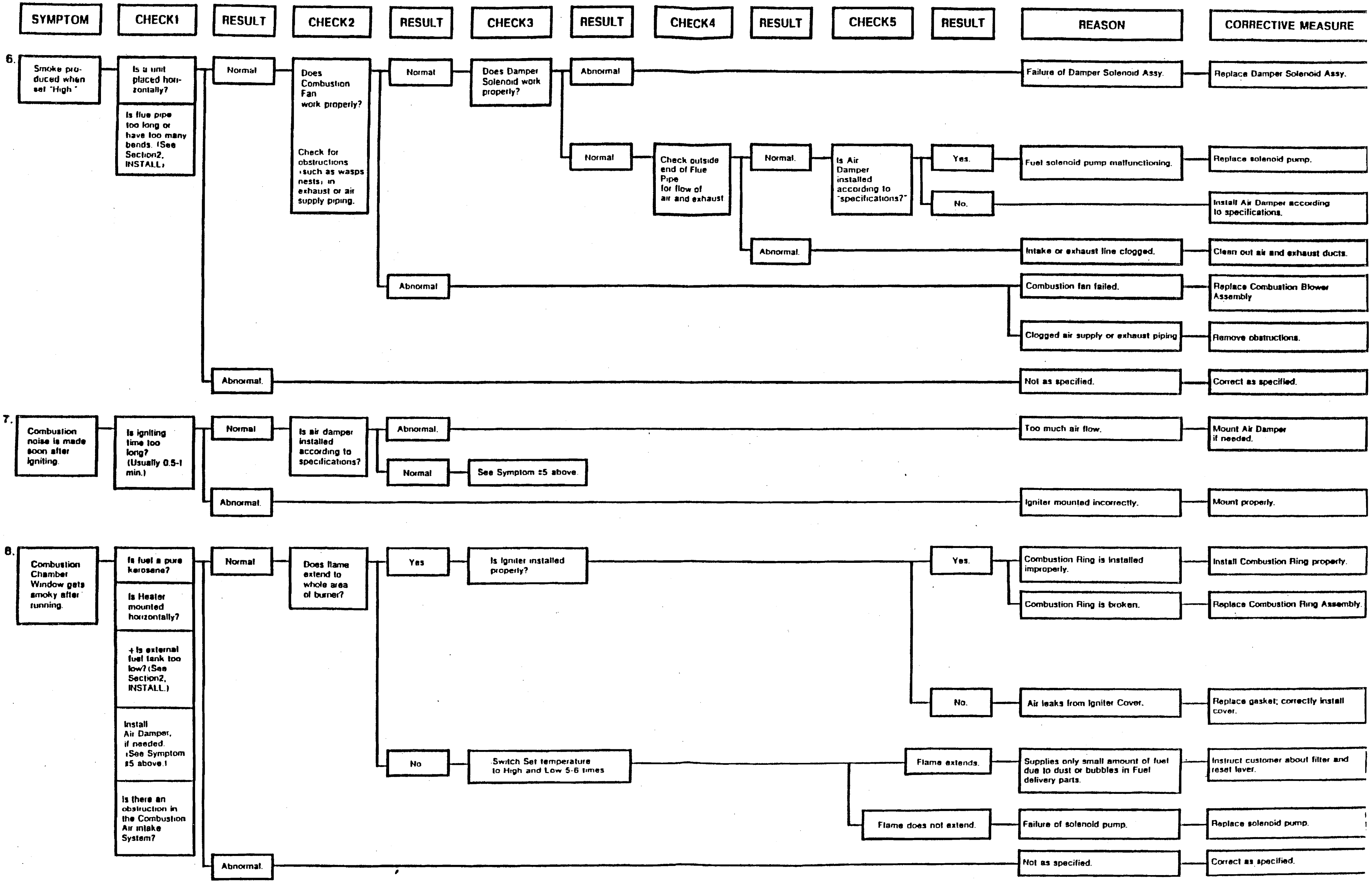




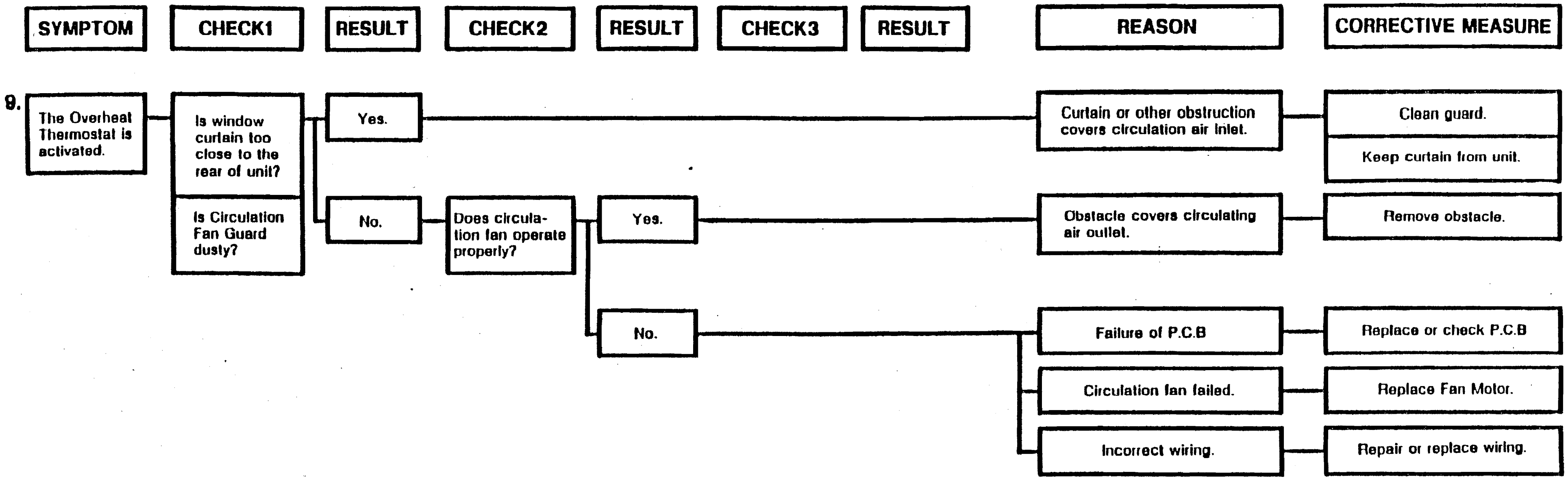
SYMPTOM	CHECK1	RESULT	CHECK2	RESULT	CHECK3	RESULT	CHECK4	RESULT	CHECK5	RESULT	REASON	CORRECTIVE MEASURE
No ignition	Is igniter red on preheat?	No	Is there 12Vdc at coil of relay RL1 on preheat?	No							Failure of micro-processor (IC1).	
											Failure of TR array(IC6).	
				Yes							Failure of relay (RL1).	
											Fuse (F2) open.	Replace fuse.
											Igniter open.	Replace igniter.
		Yes	Does combustion blower work during prepurge and igniting?	No	Is there 12Vdc between TP3 and IC6(11 pin)?	No					Failure of micro-processor (IC1).	
											Failure of TR array(IC6)	
						Yes					Failure of photo triac (IC8).	
											Failure of triac (Q1).	
											Failure of resistor. (R1, R51)	
											Failure of capacitor (C2)	
											Failure of combustion blower.	Replace combustion blower
											Incorrect wiring of combustion blower.	Correct wiring
				Yes	Does air pressure switch work normally?	No					Failure of air pressure switch.	Replace air pressure switch.
											Rubber hose is bloked on disconnected.	Clear and or correct rubber hose
											Incorrect wiring.	Correct wiring
						A						


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
A
Yes.
Does solenoid pump work?
Yes.
Failure of fuel supply parts.
Check fuel supply parts.
No.
Is there 160Vdc at diode (D2)?
Yes.
Failure of resistor (R2~R9).
Failure of capacitor (C4~C6).
Failure of zener diode (ZD1).
Failure of diode (D3~D5).
Failure of trigger diode (TD).
Failure of thyristor (Q2, Q3).
No.
Failure of diode(D2).
Failure of microprocessor (IC1).
Failure of TR array (IC6).
Failure of diode(D17).
Failure of resistor(R53).
Failure of photo triac (IC11).
Failure of transistor (Q6, Q11).

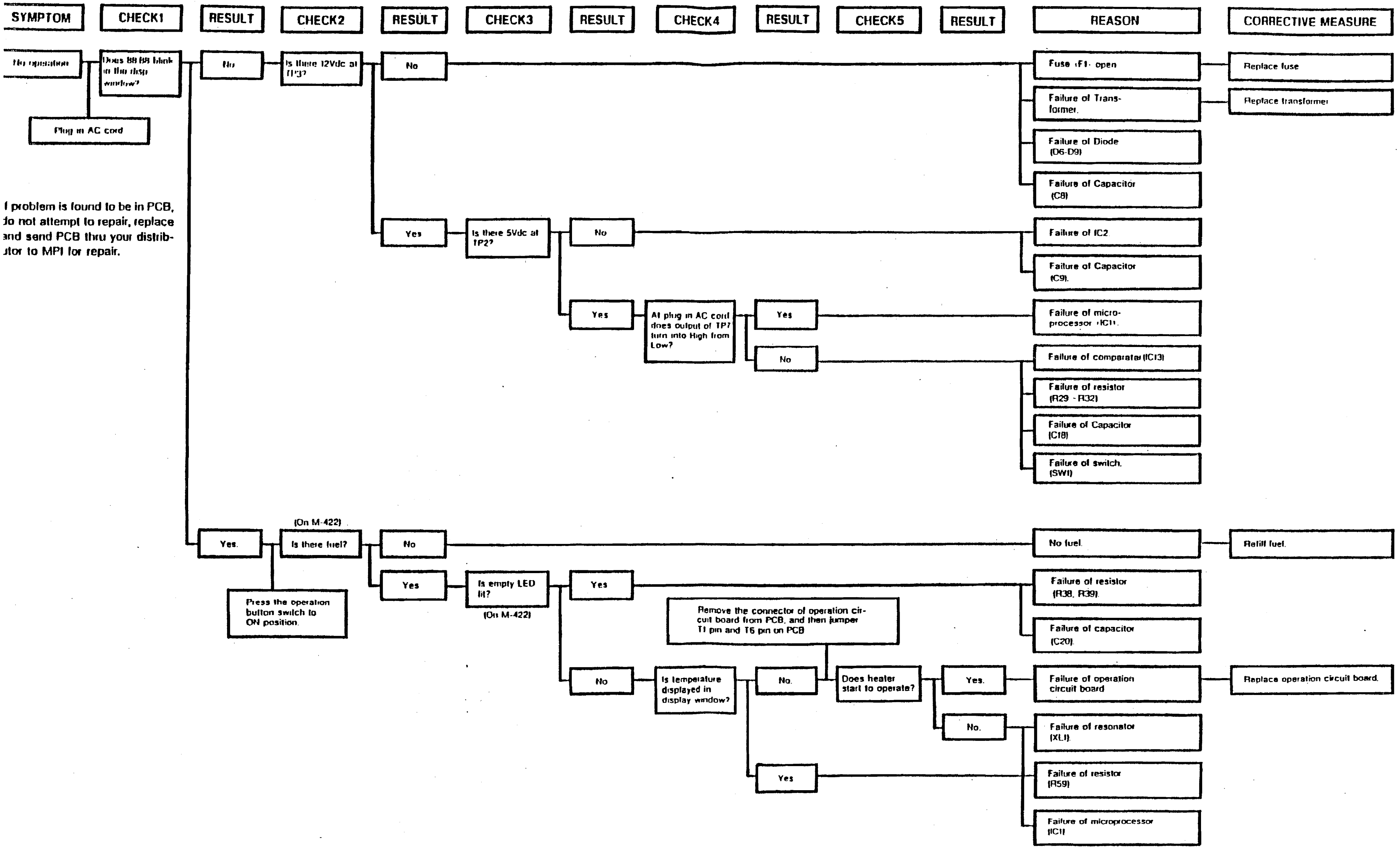

SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
REASON
CORRECTIVE MEASURE
2.
No fuel feed
No ignition
Is air trapped in fuel line?
No
Is solenoid pump operating?
Yes
Check for water in fuel
No
Fusible link valve closed on M-422
Replace handle of fusible link valve or open valve.
Tripped safety on Fuel constant level valve.
Reset Fuel constant level valve.
Burner joint clogged. (Fuel Line passageway into the Combustion Chamber near base of Burner Pot.)
Clean burner joint
Yes
Fuel not fed because of surfase tension of water.
Water gathering in fuel tank.
Discharge water.
No
Check wiring to plug "K"
Normal
Failure of Solenoid Pump.
Replace Solenoid Pump.
Abnormal
Wiring failure.
Correct or replace wires.
Yes.
Air lock.
Straighten fuel line to remove air pocket, or, correct fuel line installation.
3.
Extinguished soon after Ignition.
Is Fuel constant Level Valve Lever set?
No.
Fuel not entering into valve.
Push Fuel Constant Level Valve Set Lever 4 or 5 times.
Yes.
Fuel shortage.
1. Push Operation Button to "Off"
2. Refuel tank.
3 Turn heater on.
Overheat condition.
1. Unplug heater
2. Remove air flow obstructions and/ or determine cause of overheating.
3. Replace cover and restart heater.
1.
Flame does not increase when set at "High"
Make General Checks above
● Is fuel head too low? (See Section2, INSTALLATION)
● Is fuel line length correct?
● If using a Lifter, check Lifter installation specifications
● Is unit placed horizontally?
Normal.
Is solenoid pump High mode?
Yes.
Air present in fuel line.
Correct fuel line.
Failure of solenoid pump.
Replace solenoid pump.
No
Wiring failure.
Correct Wiring.
Failure of solenoid pump.
Replace solenoid pump.
Failure of circuit board.
Replace or check circuit board.
Abnormal
Not as specified
Correct as specified
Poor flame, sounds of combustion, soot at the rear of the heater.
(*Is not a failure, but is apt to occur)
Loose flue pipe.
Allow heater to cool completely, tighten all connection.

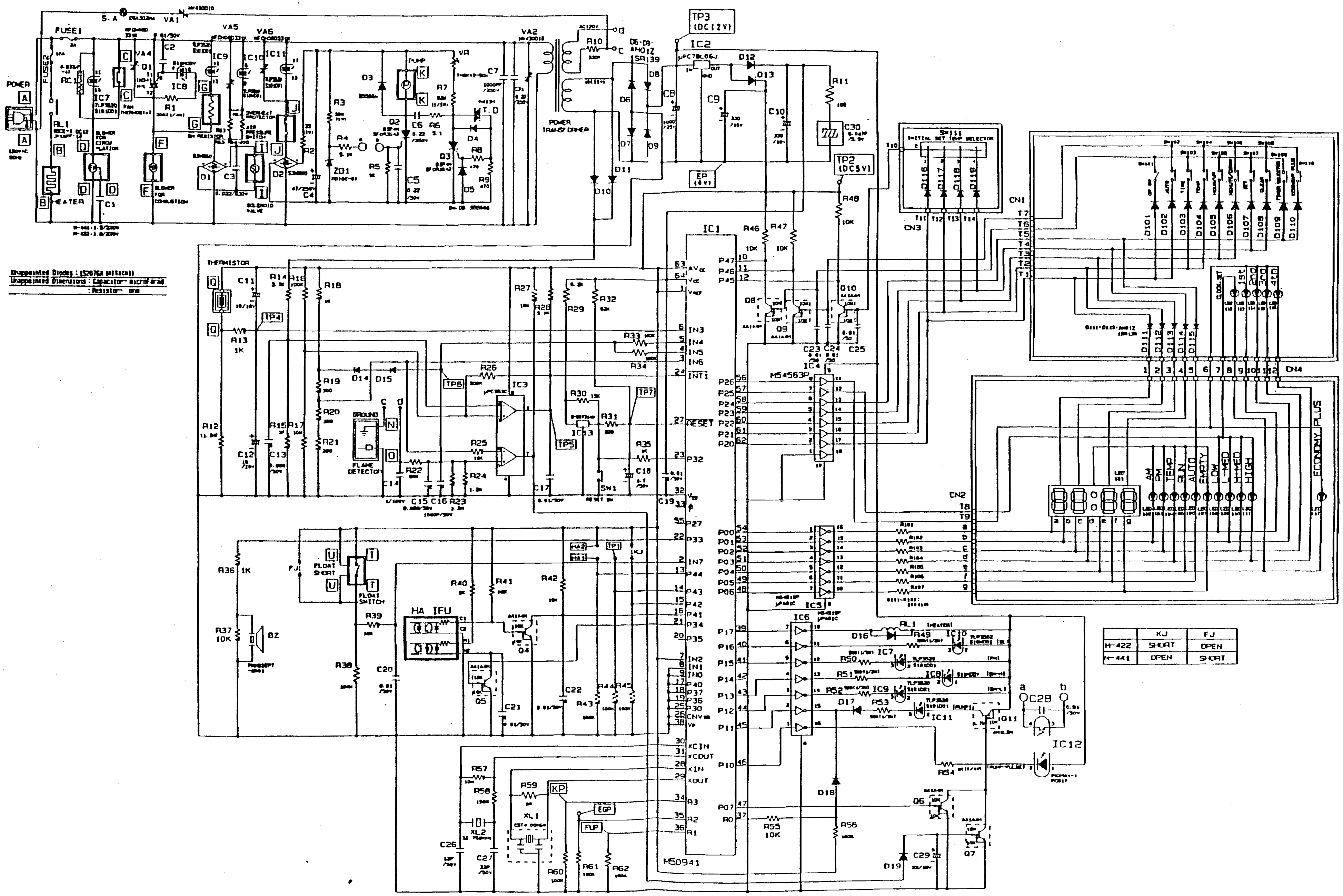


SYMPTOM	CHECK1	RESULT	CHECK2	RESULT	CHECK3	RESULT	CHECK4	RESULT	CHECK5	RESULT	REASON	CORRECTIVE MEASURE
6. Smoke produced when set "High"	Is a unit placed horizontally? Is flue pipe too long or have too many bends. (See Section2, INSTALL)	Normal	Does Combustion Fan work properly? Check for obstructions (such as wasps nests) in exhaust or air supply piping.	Normal	Does Damper Solenoid work properly?	Abnormal					Failure of Damper Solenoid Assy.	Replace Damper Solenoid Assy.
						Normal	Check outside end of Flue Pipe for flow of air and exhaust	Normal.	Is Air Damper installed according to "specifications?"	Yes.	Fuel solenoid pump malfunctioning.	Replace solenoid pump.
										No.		Install Air Damper according to specifications.
								Abnormal.			Intake or exhaust line clogged.	Clean out air and exhaust ducts.
				Abnormal							Combustion fan failed.	Replace Combustion Blower Assembly
											Clogged air supply or exhaust piping	Remove obstructions.
		Abnormal.									Not as specified.	Correct as specified.
7. Combustion noise is made soon after igniting.	Is igniting time too long? (Usually 0.5-1 min.)	Normal	Is air damper installed according to specifications?	Abnormal.							Too much air flow.	Mount Air Damper if needed.
				Normal	See Symptom #5 above.							
		Abnormal.									Igniter mounted incorrectly.	Mount properly.
8. Combustion Chamber Window gets smoky after running.	Is fuel a pure kerosene? Is Heater mounted horizontally? + Is external fuel tank too low? (See Section2, INSTALL.) Install Air Damper, if needed. (See Symptom #5 above.) Is there an obstruction in the Combustion Air intake System?	Normal	Does flame extend to whole area of burner?	Yes	Is Igniter installed properly?					Yes.	Combustion Ring is installed improperly.	Install Combustion Ring properly.
											Combustion Ring is broken.	Replace Combustion Ring Assembly.
										No.	Air leaks from Igniter Cover.	Replace gasket; correctly install cover.
				No	Switch Set temperature to High and Low 5-6 times					Flame extends.	Supplies only small amount of fuel due to dust or bubbles in Fuel delivery parts.	Instruct customer about filter and reset lever.
										Flame does not extend.	Failure of solenoid pump.	Replace solenoid pump.
		Abnormal.									Not as specified.	Correct as specified.


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
REASON
CORRECTIVE MEASURE
9.
The Overheat Thermostat is activated.
Is window curtain too close to the rear of unit?
Is Circulation Fan Guard dusty?
Yes.
Curtain or other obstruction covers circulation air inlet.
Clean guard.
Keep curtain from unit.
No.
Does circulation fan operate properly?
Yes.
Obstacle covers circulating air outlet.
Remove obstacle.
No.
Failure of P.C.B
Replace or check P.C.B
Circulation fan failed.
Replace Fan Motor.
Incorrect wiring.
Repair or replace wiring.

f problem is found to be in PCB, do not attempt to repair, replace and send PCB thru your distrib-utor to MPI for repair.


SYMPTOM
CHECK1
RESULT
CHECK2
RESULT
CHECK3
RESULT
CHECK4
RESULT
CHECK5
RESULT
REASON
CORRECTIVE MEASURE
No operation
Does 88:88 blink in the disp window?
Plug in AC cord
No
Is there 12Vdc at TP3?
No
Fuse (F1) open
Replace fuse
Failure of Trans-former.
Replace transformer
Failure of Diode (D6-D9)
Failure of Capacitor (C8)
Yes
Is there 5Vdc at TP2?
No
Failure of IC2
Failure of Capacitor (C9).
Yes
At plug in AC cord does output of TP7 turn into High from Low?
Yes
Failure of micro-processor (IC1).
No
Failure of comparator (IC13)
Failure of resistor (R29 - R32)
Failure of Capacitor (C18)
Failure of switch. (SW1)
Yes.
Press the operation button switch to ON position.
(On M-422)
Is there fuel?
No
No fuel.
Refill fuel.
Yes
Is empty LED lit?
(On M-422)
Yes
Failure of resistor (R38, R39).
Failure of capacitor (C20).
No
Is temperature displayed in display window?
No.
Remove the connector of operation cir-cuit board from PCB, and then jumper T1 pin and T6 pin on PCB
Does heater start to operate?
Yes.
Failure of operation circuit board
Replace operation circuit board.
No.
Failure of resonator (XL1).
Yes
Failure of resistor (R59)
Failure of microprocessor (IC1)


POWER
120VAC 60Hz
FUSE1
FUSE2
S.A
VA1
VA2
VA4
VA5
VA6
RC1
RL1
IC7
IC8
IC9
IC10
IC11
C1
C2
C3
C4
C5
C6
C7
R1
R2
R3
R4
R5
R6
R7
R8
R9
D1
D2
D3
D4
D5
ZD1
HEATER
BLOWER FOR CIRCULATION
BLOWER FOR COMBUSTION
SOLENOID VALVE
OVER-HEAT PROTECTOR
AIR PRESSURE SWITCH
PUMP
VR
T.D
POWER TRANSFORMER
R10
D6-D9 AH01Z 1SR139
D6
D7
D8
D9
D10
D11
C8
C9
C10
TP3 (DC12V)
IC2
μPC78L06J
D12
D13
R11
C30
EP (0V)
TP2 (DC5V)
R48
SW111 INITIAL SET TEMP SELECTOR
D116
D117
D118
D119
T10
T11
T12
T13
T14
CN3
CN1
T1
T2
T3
T4
T5
T6
T7
D101
D102
D103
D104
D105
D106
D107
D108
D109
D110
CLOCK SET
1st
2nd
3rd
4th
D111
D112
D113
D114
D115
CN4
1 2 3 4 5 6 7 8 9 10 11 12
THERMISTOR
C11
R14
R16
R18
TP4
R13 1K
R12
C12
C13
R15
R17
R19
R20
R21
D14
D15
TP6
R26
IC3
μPC393C
R25
GROUND
FLAME DETECTOR
C14
R22
C15
C16
R23
R24
N
O
Q
R27
R28
R29
R32
R33
R34
R30
IC13
R31
TP7
TP5
C17
R35
C18
SW1
RESET SW
C19
IC1
M50941
AVcc
Vcc
VREF
IN3
IN4
IN5
IN6
INT1
RESET
P32
Vss
φ
P27
P33
IN7
P44
P43
P42
P41
P34
P35
IN2
IN1
IN0
P40
P37
P36
P30
CNVss
Vp
XCIN
XCOUT
XIN
XOUT
R3
R2
R1
P47
P46
P45
R46
R47
Q8
Q9
Q10
C23
C24
C25
IC4
M54563P
P26
P25
P24
P23
P22
P21
P20
CN2
T8
T9
a b c d e f g
AM
PM
TEMP
RUN
AUTO
EMPTY
LOW
L-MED
H-MED
HIGH
ECONOMY PLUS
P00
P01
P02
P03
P04
P05
P06
IC5
R101
R102
R103
R104
R105
R106
R107
R36 1K
R37 10K
BZ
FJ
FLOAT SHORT
FLOAT SWITCH
U
T
R39
R38
C20
HA
IFU
R40
R41
R42
Q4
Q5
C21
C22
R43
R44
R45
HA2
HA1
TP1
KJ
IC6
P17
P16
P15
P14
P13
P12
P11
P10
P07
P0
AL1 (HEATER)
D16
R49
R50
R51
R52
R53
R54
D17
IC11
Q11
a
b
C28
IC12
D18
R55 10K
R56
Q6
Q7
C29
D19
R57
R58
R59
KP
XL1
XL2
C26
C27
EGP
FUP
R60
R61
R62

Unappointed Diodes : 1S2076A (Hitachi)

Unappointed Dimensions : Capacitor– microFarad

: Resistor– ohm

	KJ	FJ
H-422	SHORT	OPEN
H-441	OPEN	SHORT

CONNECTION OF LEAD WIRES

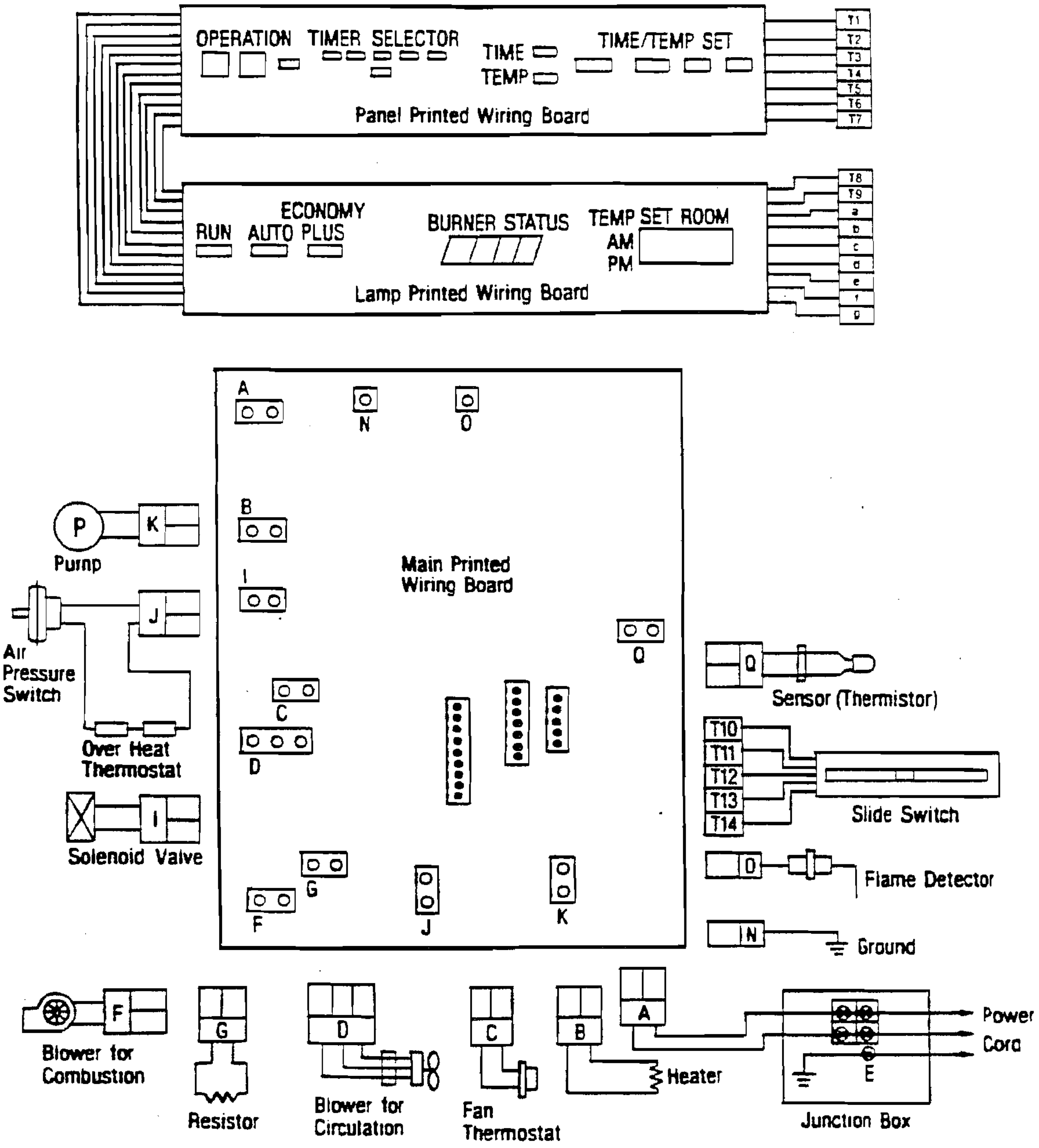

OPERATION
TIMER SELECTOR
TIME
TEMP
TIME/TEMP SET
Panel Printed Wiring Board
T1
T2
T3
T4
T5
T6
T7
ECONOMY
RUN
AUTO
PLUS
BURNER STATUS
TEMP SET ROOM
AM
PM
Lamp Printed Wiring Board
T8
T9
a
b
c
d
e
f
g
A
N
O
B
I
Main Printed Wiring Board
Q
C
D
G
F
J
K
P
Pump
K
J
Air Pressure Switch
Over Heat Thermostat
I
Solenoid Valve
Q
Sensor (Thermistor)
T10
T11
T12
T13
T14
Slide Switch
O
Flame Detector
N
Ground
F
Blower for Combustion
G
Resistor
D
Blower for Circulation
C
Fan Thermostat
B
Heater
A
E
Junction Box
Power Cord

figure 7-1 Monitor441

CONNECTION OF LEAD WIRES

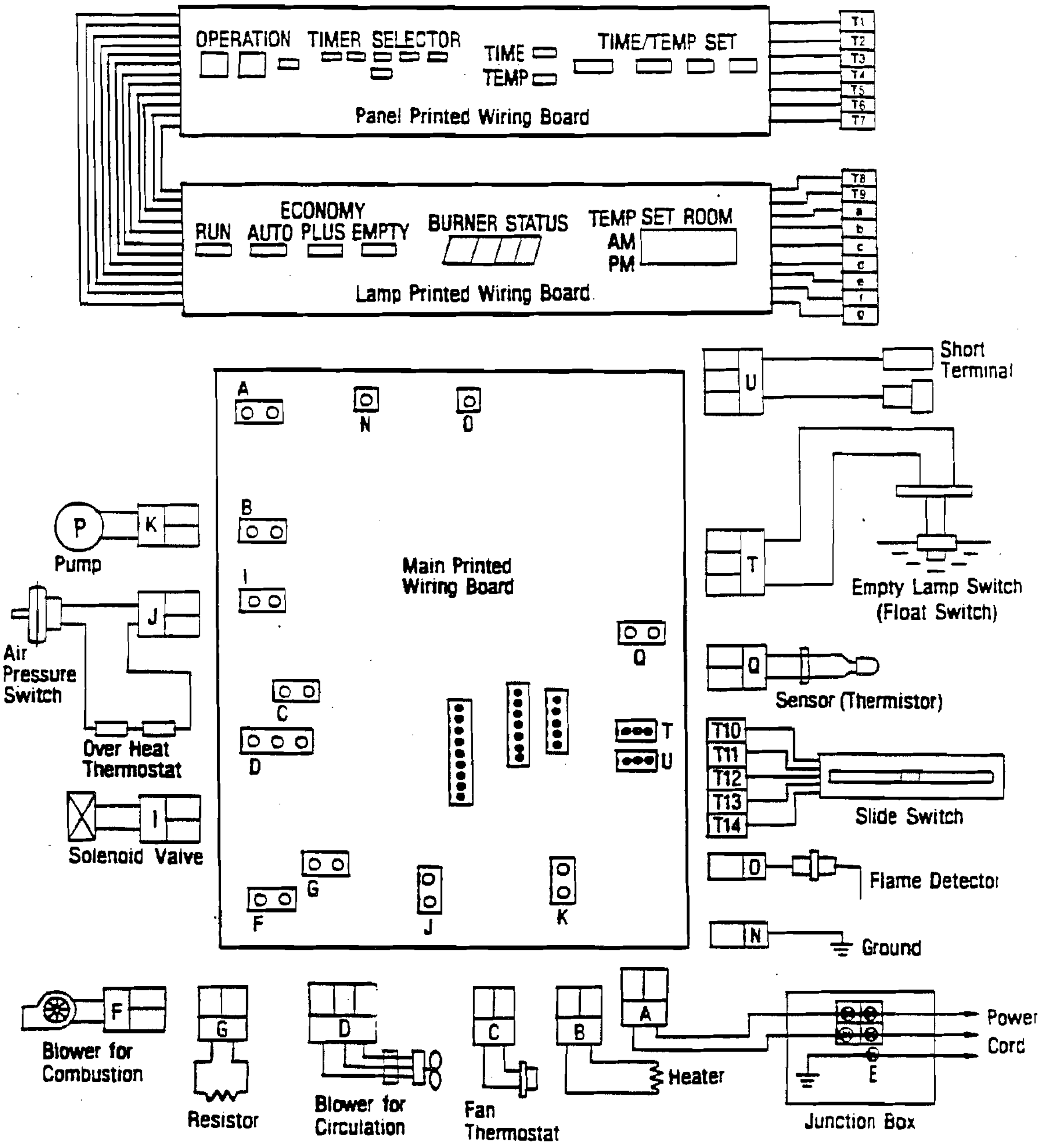

OPERATION
TIMER SELECTOR
TIME
TEMP
TIME/TEMP SET
Panel Printed Wiring Board
T1
T2
T3
T4
T5
T6
T7
T8
T9
a
b
c
d
e
f
g
RUN
AUTO
ECONOMY
PLUS
EMPTY
BURNER STATUS
TEMP SET ROOM
AM
PM
Lamp Printed Wiring Board
A
N
O
B
I
Main Printed
Wiring Board
Q
C
D
T
U
G
F
J
K
P
Pump
Air
Pressure
Switch
Over Heat
Thermostat
Solenoid Valve
Short
Terminal
Empty Lamp Switch
(Float Switch)
Sensor (Thermistor)
T10
T11
T12
T13
T14
Slide Switch
Flame Detector
Ground
Blower for
Combustion
Resistor
Blower for
Circulation
Fan
Thermostat
Heater
E
Junction Box
Power
Cord

figure 7-2 Monitor422

MANOMETER READINGS

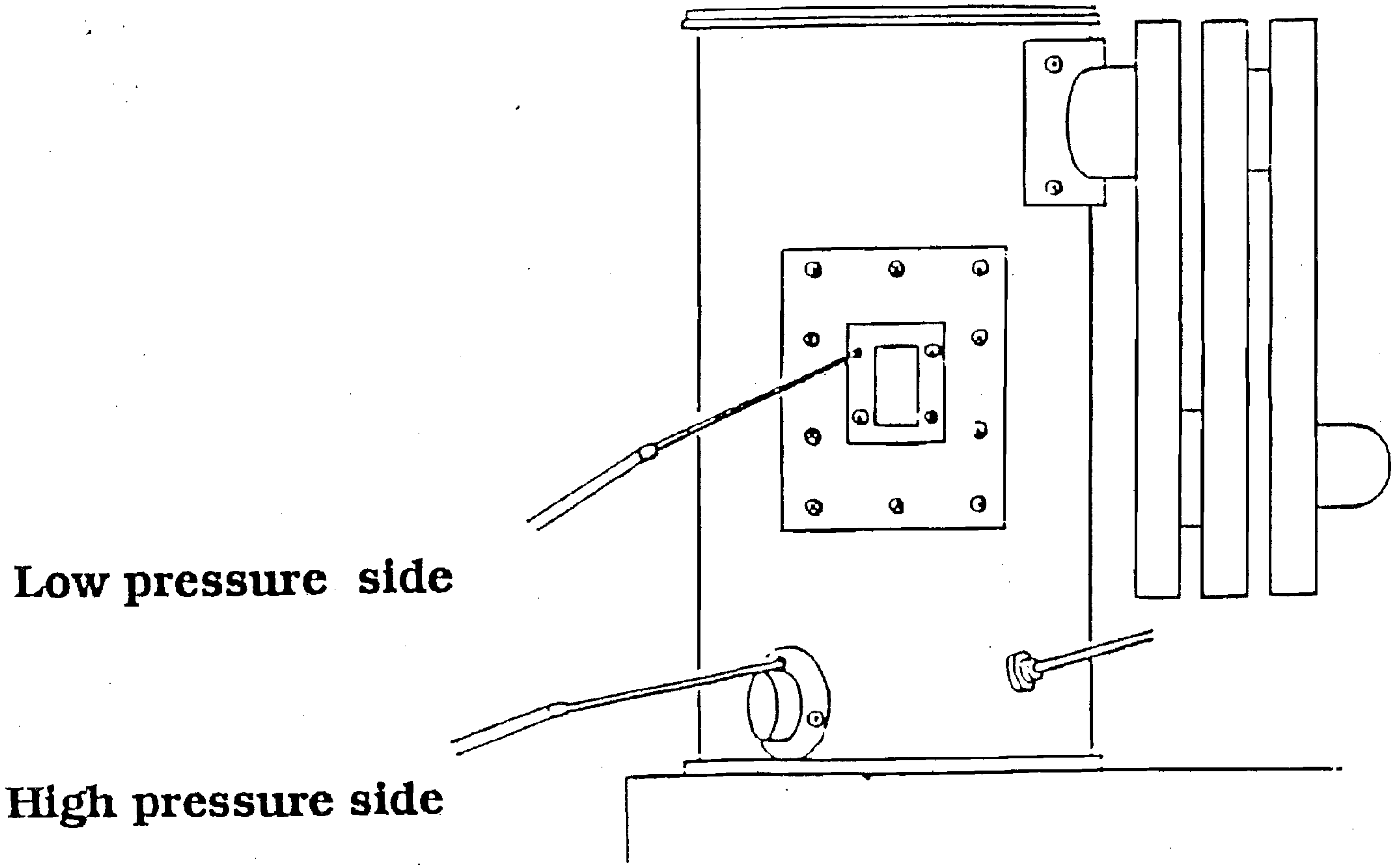
21,22,422

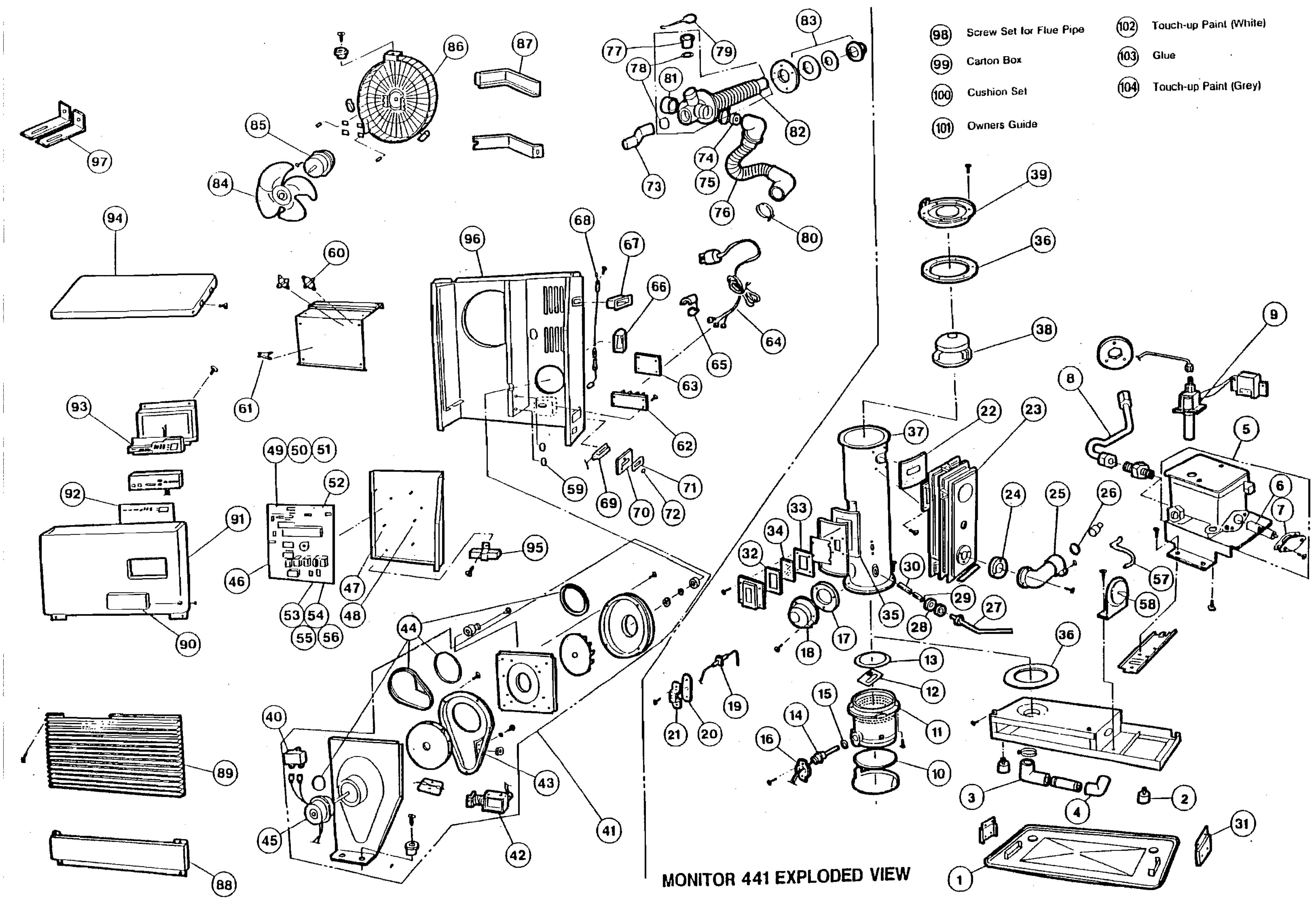
Lo/Lo Med	1.5 - 2.0 mm/H2o	Fan Lo Speed Damper C
Med Hi	3.2 - 3.6 mm/H2o	Fan Lo Speed Damper O
Hi	3.8 - 4.2 mm/H2o	Fan Hi Speed Damper O

40,41,441

Lo/Lo Med	2.5 - 3.0 mm/H2o	Fan Lo Speed Damper C
Med Hi	5.8 - 6.4 mm/H2o	Fan Lo Speed Damper O
Hi	6.8 - 7.4 mm/H2o	Fan Hi Speed Damper O

Note: These Readings are to be taken after the heater has fully warmed up. (Approximately 5 minutes on Hi fire.) The damper adjustment can only be done on Low or Low-Med Ranges.


Low pressure side
High pressure side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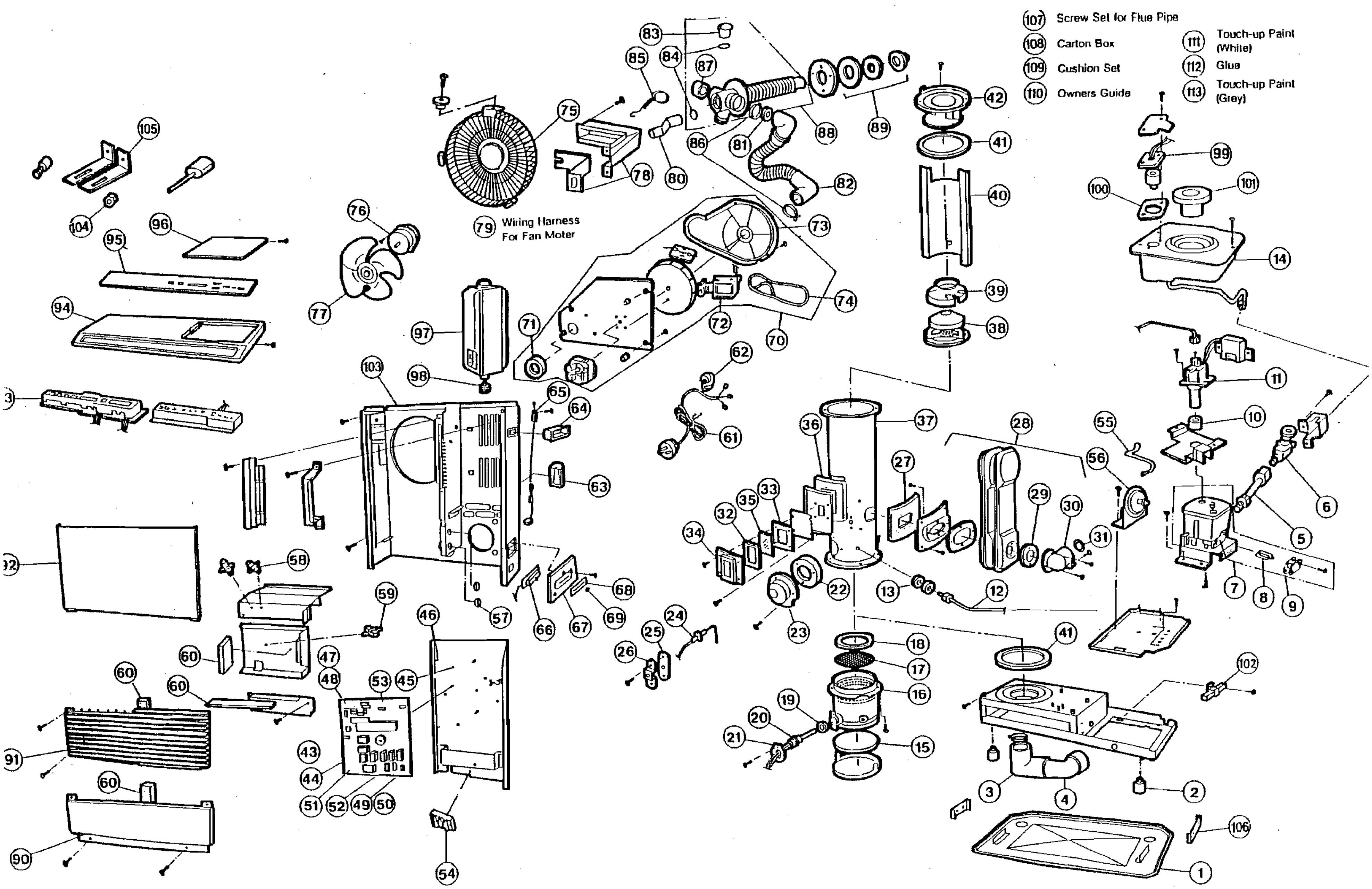
(98)	Screw Set for Flue Pipe
(99)	Carton Box
(100)	Cushion Set
(101)	Owners Guide
(102)	Touch-up Paint (White)
(103)	Glue
(104)	Touch-up Paint (Grey)

MONITOR 441 EXPLODED VIEW

MONITOR 441 SERVICE PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION	ITEM NO.	PART NO.	DESCRIPTION
1	6400	SPILL TRAY	55	6204	PHOTO COUPLER IC12
2	5019	LEG	56	6251	POWER TRANSFORMER
3	6301	AIR SUPPLY HOSE (A)	57	6326	AIR LINE
4	6302	AIR SUPPLY HOSE (B)	58	6343	AIR PRESSURE SWITCH
5	6303	CONSTANT LEVEL VALVE	59	6136	RUBBER BUSH
6	6304	C.L.V. STRAINER	60	6463	OVER HEAT THERMOSTAT
7	6344	STRAINNER GASKET	61	6464	FAN THERMOSTAT
8	6467	FUEL PIPE	62	6137	CORD CONNECTOR
9	6450	SOLENOID PUMP	63	6466	JUNCTION BOX COVER
10	6357	GASKET (1)	64	6139	POWER SUPPLY CORD
11	6401	BURNER	65	4833	CORD BUSHING
12	6363	BURNER CLOTH	66	6037	LEVEL GUIDE
13	6358	ROPE GASKET	67	6138	CARRYING HANDLE
14	6311	HEATER	68	6186	SENSOR ASSY
15	6115	GASKET (3)	69	6278	SLIDE SWITCH ASSY
16	6402	IGNITER BRACKET	70	6206	SLIDE SWITCH COVER
17	6354	HEATER COVER PACKING	71	6207	SLIDE SWITCH PANEL
18	6403	IGNITER COVER	72	6208	SLIDE SWITCH KNOB
19	6355	FLAME DETECTIVE PLUG	73	4004	JOINT PIPE
20	6119	PLUG PACKING	74	6407	AIR DAMPER (E)
21	6196	FL PLUG BRACKET	75	6408	AIR DAMPER (S)
22	6313	GASKET (4)	76	6145	AIR SUPPLY HOSE ASSY
23	6314	HEAT EXCHANGER ASSY	77	4014	EXHAUST OUTLET CAP
24	6122	GASKET (6)	78	4016	AIR PORT O RING
25	6123	EXHAUST DUCT	79	4006	PIPE HOLDER
26	6176	O-RING (P39)	80	4008	HOSE BAND
27	6315	OIL SUMP PIPE	81	4805	AIR OUTLET CAP
28	6164	JOINT SEAL PACKING	82	6147	FLUE PIPE ASSY
29	6352	FUEL NOZZLE	83	6148	SLEEVE FLANGE SET
30	6353	FUEL NOZZLE COVER	84	6075	FAN
31	6404	BASE TRAY RETAINER	85	6453	CIRCULATION MOTOR
32	6124	WINDOW GASKET	86	6454	BLOWER GUARD
33	6125	WINDOW FRAME GASKET	87	6455	WIRING GUARD
34	6405	WINDOW GLASS	88	6332	UNDER COVER
35	6350	WINDOW BASE GASKET	89	6409	LOUVER
36	6317	CHAMBER GASKET	90	6456	CONTROL COVER
37	6349	COMBUSTION CHAMBER	91	6457	FRONT COVER
38	6356	COMBUSTION RING ASSY	92	6458	LAMP PANEL
39	6321	CHAMBER CAP	93	6266	SWITCH & LAMP ASSY
40	6322	CONDENSER (2.5 μFD)	94	6337	TOP COVER
41	6323	BLOWER ASSY	95	6338	RESISTOR
42	6406	DAMPER SOLENOID ASSY	96	6465	CABINET ASSY
43	6324	SUCTION CASE A ASSY	97	6194	WALL CLAMPS
44	6144	SEAL PACKING	98	6197	SCREW SET FOR FLUE PIPE
45	6348	MOTER FOR COMBUSTION	99	6459	CARTON BOX
46	6451	PWB ASSY	100	6342	CUSHION SET
47	6461	PWB SPACER CLIP (A)	101	1153	OWNERS GUIDE
48	6462	PWB SPACER CLIP (B)	102	8216	TOUCH-UP PAINT (WHITE)
49	6253	MICROPROCESSOR	103	8217	GLUE
50	6203	BUZZER	104	8219	TOUCH-UP PAINT (GREY)
51	6172	FUSE (250V 10A)			
52	6173	FUSE (250V 2A)			
53	6452	CAPACITOR (1.5 μFD)			
54	6187	TR ARRAY (M54563P) IC4			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79 Wiring Harness For Fan Moter
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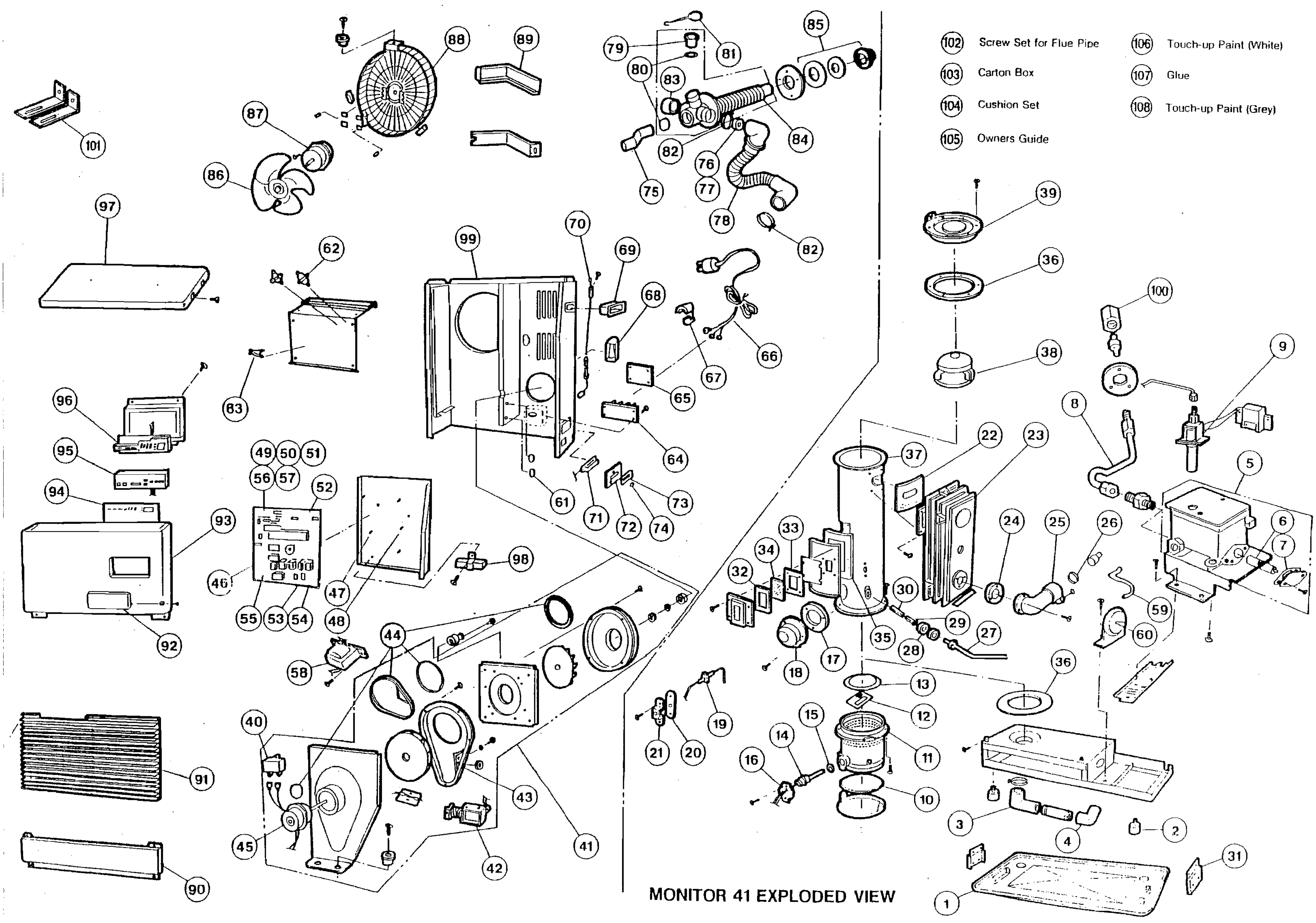
(107) Screw Set for Flue Pipe
(108) Carton Box
(109) Cushion Set
(110) Owners Guide
(111) Touch-up Paint (White)
(112) Glue
(113) Touch-up Paint (Grey)

MONITOR 422 EXPLODED VIEW

MONITOR 422 SERVICE PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION
1	6200	SPILL TRAY
2	5019	LEG
3	6101	AIR SUPPLY HOSE (A)
4	6102	AIR SUPPLY HOSE (B)
5	6103	FUEL PIPE
6	6104	FUSIBLE VALVE
7	6105	CONSTANT LEVEL VALVE
8	6106	C.L.V. STRAINER
9	6189	STRAINER GASKET
10	6108	SOLENOID PUMP PACKING
11	6250	SOLENOID PUMP
12	6110	OIL SUMP PIPE
13	6164	JOINT SEAL PACKING
14	6111	FUEL SUMP
15	6112	GASKET (1)
16	6182	BURNER
17	6113	BURNER CLOTH
18	6114	GASKET (2)
19	6115	GASKET (3)
20	6277	HEATER
21	6195	IGNITER BRACKET
22	6117	HEATER COVER PACKING
23	6191	IGNITER COVER
24	6118	FLAME DETECTIVE PLUG
25	6119	PLUG PACKING
26	6196	FL PLUG BRACKET
27	6120	GASKET (4)
28	6121	HEAT EXCHANGER ASSY
29	6122	GASKET (6)
30	6123	EXHAUST DUCT
31	6176	O-RING (P39)
32	6124	WINDOW GASKET
33	6125	WINDOW FRAME GASKET
34	6068	WINDOW PLATE
35	6069	WINDOW GLASS
36	6126	WINDOW BASE GASKET
37	6127	COMBUSTION CHAMBER ASSY
38	6181	COMBUSTION RING ASSY
39	6128	BURNER CAP
40	6129	BAFFLE ASSY
41	6130	CHAMBER GASKET
42	6131	CHAMBER CAP
43	6251	POWER TRANSFORMER
44	6252	PWB ASSY
45	6134	PWB SPACER CLIP (A)
46	6135	PWB SPACER CLIP (B)
47	6253	MICROPROCESSOR
48	6203	BUZZER
49	6172	FUSE (250V 10A)
50	6173	FUSE (250V 2A)
51	6256	CAPACITOR (1.8 μFD)
52	6187	TR ARRAY (M54563P) IC4
53	6204	PHOTO COUPLER IC12
54	6137	CORD CONNECTOR
55	6107	AIR LINE
56	6184	AIR PRESSURE SWITCH
57	6136	RUBBER BUSH
58	6273	OVER HEAT THERMOSTAT
59	6260	FAN THERMOSTAT
60	6163	AIR PACKING SET
61	6139	POWER SUPPLY CORD
62	4833	CORD BUSHING
63	6037	LEVEL GUIDE
64	6138	CARRYING HANDLE
65	6186	SENSOR ASSY
66	6278	SLIDE SWITCH ASSY
67	6206	SLIDE SWITCH COVER
68	6207	SLIDE SWITCH PANEL
69	6208	SLIDE SWITCH KNOB
70	6140	BLOWER ASSY
71	6141	BLOWER MOUTH PACKING
72	6142	DAMPER SOLENOID ASSY
73	6143	SUCTION CASE
74	6144	SEAL PACKING
75	6261	BLOWER GUARD
76	6262	CIRCULATION MOTOR
77	6180	FAN BLADE
78	6263	WIRING GUARD
79	6264	WIRING HARNESS FOR FAN MOTER
80	4004	JOINT PIPE
81	6209	AIR DAMPER (S)
82	6145	AIR SUPPLY HOSE ASSY
83	4014	EXHAUST OUTLET CAP
84	4016	AIR PORT O RING
85	4006	PIPE HOLDER
86	4008	HOSE BAND
87	4805	AIR OUTLET CAP
88	6147	FLUE PIPE ASSY
89	6148	SLEEVE FLANGE SET
90	6149	UNDER COVER
91	6210	LOUVER
92	6265	FRONT COVER
93	6266	SWITCH & LAMP ASSY
94	6267	TOP COVER
95	6268	LAMP PANEL
96	6158	FUEL TANK COVER
97	6159	FUEL TANK ASSY
98	6179	FUEL TANK CAP
99	6269	FLOAT SWITCH
100	6178	FLOAT SWITCH PACKING
101	6177	OIL FILTER
102	6162	RESISTOR
103	6270	CABINET ASSY
104	6345	UNION NUT
105	6194	WALL CLAMPS
106	6214	BASE TRAY RETAINER
107	6197	SCREW SET FOR FLUE PIPE
108	6271	CARTON BOX
109	6175	CUSHION SET
110	1154	OWNERS GUIDE
111	8216	TOUCH-UP PAINT (WHITE)
112	8217	GLUE
113	8219	TOUCH-UP PAINT (GREY)
114	6216	FUEL NOZZLE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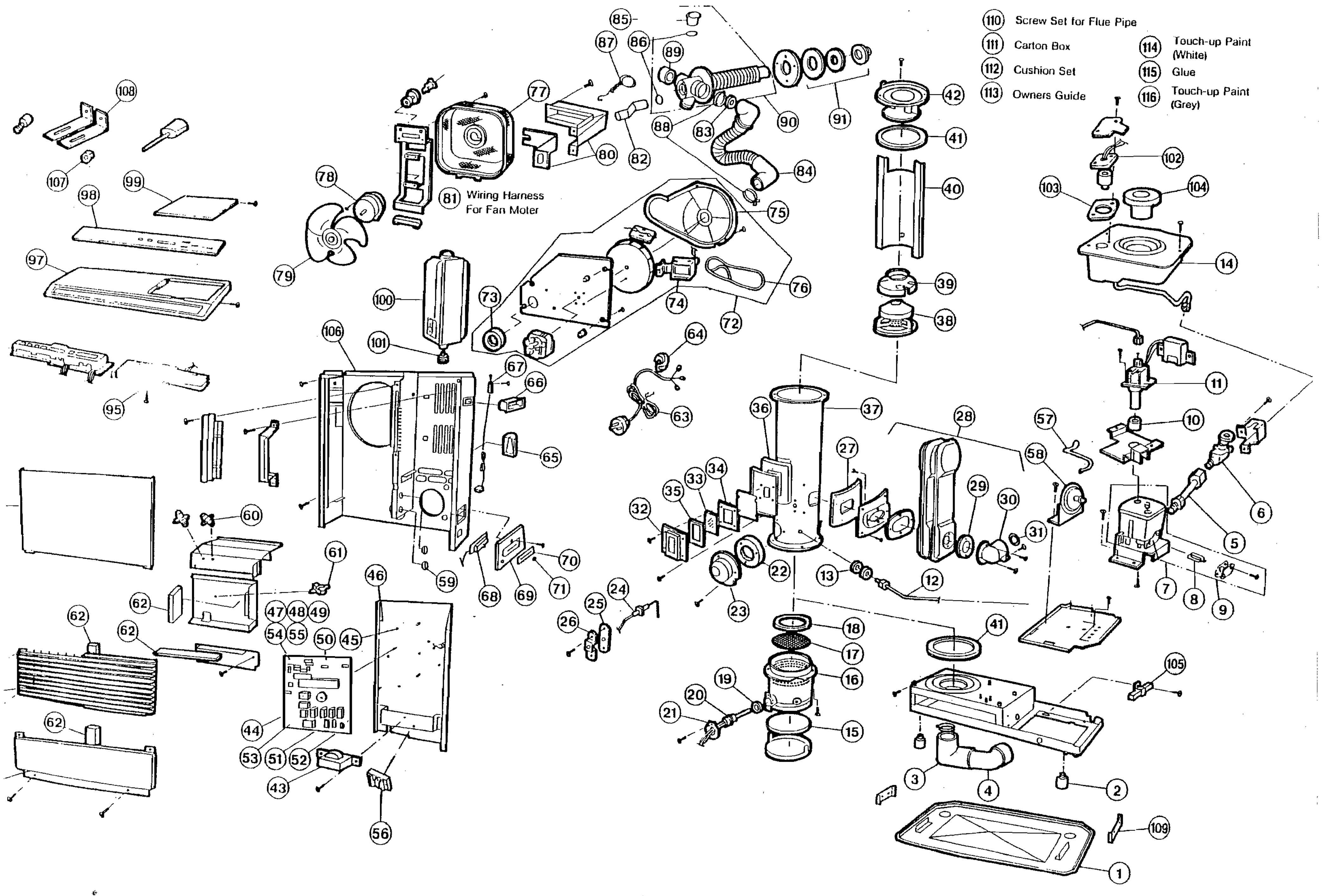
(102)	Screw Set for Flue Pipe
(103)	Carton Box
(104)	Cushion Set
(105)	Owners Guide
(106)	Touch-up Paint (White)
(107)	Glue
(108)	Touch-up Paint (Grey)

MONITOR 41 EXPLODED VIEW

MONITOR 41 SERVICE PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION	ITEM NO.	PART NO.	DESCRIPTION
1	6400	SPILL TRAY	55	6340	CAPACITOR (1.8 μFD)
2	5019	LEG	56	6187	TR ARRAY (M54563P)IC3
3	6301	AIR SUPPLY HOSE (A)	57	6204	PHOTO COUPLER(IC9~11)
4	6302	AIR SUPPLY HOSE (B)	58	6132	POWER TRANSFOPMER
5	6303	CONSTANT LEVEL VALVE	59	6326	AIR LINE
6	6304	C.L.V.STRAINER	60	6343	AIR PRESSURE SW
7	6344	STRAINER GASKET	61	6136	RUBBER BUSH
8	6305	FUEL PIPE	62	6327	OVER HEAT THERMOSTAT
9	6306	SOLENOID PUMP	63	6152	FAN THERMOSTAT
10	6357	GASKET (1)	64	6137	CORD CONNECTOR
11	6401	BURNER	65	6032	JUNCTION BOX COVER
12	6363	BURNER CLOTH	66	6139	POWER SUPPLY CORD
13	6358	ROPE GASKET	67	4833	CORD BUSHING
14	6311	HEATER	68	6037	LEVEL GUIDE
15	6115	GASKET (3)	69	6138	CARRYING HANDLE
16	6402	IGNITER BRACKET	70	6186	SENSOR ASSY
17	6354	HEATER COVER PACKING	71	6205	SLIDE SWITCH ASSY
18	6403	IGNITER COVER	72	6206	SLIDE SWITCH COVER
19	6355	FLAME DETECTIVE PLUG	73	6207	SLIDE SWITCH PANEL
20	6119	PLUG PACKING	74	6208	SLIDE SWITCH KNOB
21	6196	FL PLUG BRACKET	75	4004	JOINT PIPE
22	6313	GASKET (4)	76	6407	AIR DAMPER (E)
23	6314	HEAT EXCHANGER ASSY	77	6408	AIR DAMPER (S)
24	6122	GASKET (6)	78	6145	AIR SUPPLY HOSE ASSY
25	6123	EXHAUST DUCT	79	4014	EXHAUST OUTLET CAP
26	6176	O-RING (P39)	80	4016	AIR PORT O RING
27	6315	OIL SUMP PIPE	81	4006	PIPE HOLDER
28	6164	JOINT SEAL PACKING	82	4008	HOSE BAND
29	6352	FUEL NOZZLE	83	4805	AIR OUTLET CAP
30	6353	FUEL NOZZLE COVER	84	6147	FLUE PIPE ASSY
31	6404	BASE TRAY RETAINER	85	6148	SLEEVE FLANGE SET
32	6124	WINDOW GASKET	86	6075	FAN
33	6125	WINDOW FRAME GASKET	87	6330	CIRCULATION MOTOR
34	6405	WINDOW GLASS	88	6331	BLOWER GUARD
35	6350	WINDOW BASE GASKET	89	6347	WIRING GUARD
36	6317	CHAMBER GASKET	90	6332	UNDER COVER
37	6349	COMBUSTION CHAMBER	91	6409	LOUVER
38	6356	COMBUSTION RING ASSY	92	6410	CONTROL COVER
39	6321	CHAMBER GAP	93	6411	FRONT COVER
40	6322	CONDENSER (2.5 μFD)	94	6412	LAMP PANEL
41	6323	BLOWER ASSY	95	6154	SWITCH ASSY
42	6406	DAMPER SOLENOID ASSY	96	6155	LAMP ASSY
43	6324	SUCTION CASE A ASSY	97	6337	TOP COVER
44	6144	SEAL PACKING	98	6338	RESISTOR
45	6348	MOTOR FOR COMBUSTION	99	6413	CABINET ASSY
46	6362	PWB ASSY	100	6345	UNION NUT
47	6134	PWB SPACER CLIP (A)	101	6194	WALL CLAMPS
48	6135	PWB SPACER CLIP (B)	102	6197	SCREW SET FOR FLUE PIPE
49	6202	MICROPROCESSOR	103	6414	CARTON BOX
50	6168	RELAY (A)	104	6342	CUSHION SET
51	6169	RELAY (B)	105	1148	OWNERS GUIDE
52	6203	BUZZER	106	8216	TOUCH-UP PAINT(WHITE)
53	6172	FUSE (250V 10A)	107	8217	GLUE
54	6173	FUSE (250V 2A)	108	8219	TOUCH-UP PAINT(GREY)



⑩ Screw Set for Flue Pipe
⑪ Carton Box
⑫ Cushion Set
⑬ Owners Guide
⑭ Touch-up Paint (White)
⑮ Glue
⑯ Touch-up Paint (Grey)
81 Wiring Harness For Fan Moter
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MONITOR 22 EXPLODED VIEW

MONITOR 22 SERVICE PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION	ITEM NO.	PART NO.	DESCRIPTION
1	6200	SPILL TRAY	59	6136	RUBBER BUSH
2	5019	LEG	60	6151	OVER HEAT THERMOSTAT
3	6101	AIR SUPPLY HOSE (A)	61	6152	FAN THERMOSTAT
4	6102	AIR SUPPLY HOSE (B)	62	6163	AIR PACKING SET
5	6103	FUEL PIPE	63	6139	POWER SUPPLY CORD
6	6104	FUSIBLE VALVE	64	4833	CORD BUSHING
7	6105	CONSTANT LEVEL VALVE	65	6037	LEVEL GUIDE
8	6106	C.L.V.STRAINER	66	6138	CARRYING HANDLE
9	6189	STRAINER GASKET	67	6186	SENSOR ASSY
10	6108	SOLENOID PUMP PACKING	68	6205	SLIDE SWITCH ASSY
11	6109	SOLENOID PUMP	69	6206	SLIDE SWITCH COVER
12	6110	OIL SUMP PIPE	70	6207	SLIDE SWITCH PANEL
13	6164	JOINT SEAL PACKING	71	6208	SLIDE SWITCH KNOB
14	6111	FUEL SUMP	72	6140	BLOWER ASSY
15	6112	GASKET (1)	73	6141	BLOWER MOUTH PACKING
16	6182	BURNER	74	6142	DAMPER SOLENOID ASSY
17	6113	BURNER CLOTH	75	6143	SUCTION CASE
18	6114	GASKET (2)	76	6144	SEAL PACKING
19	6115	GASKET (3)	77	6160	BLOWER GUARD
20	6116	HEATER	78	6161	CIRCULATION MOTOR
21	6195	IGNITER BRACKET	79	6180	FAN BLADE
22	6117	HEATER COVER PACKING	80	6192	WIRING GUARD
23	6191	IGNITER COVER	81	6193	WIRING HARNESS(FAN MOTOR)
24	6118	FLAME DETECTIVE PLUG	82	4004	JOINT PIPE
25	6119	PLUG PACKING	83	6209	AIR DAMPER (S)
26	6196	FL PLUG BRACKET	84	6145	AIR SUPPLY HOSE ASSY
27	6120	GASKET (4)	85	4014	EXHAUST OUTLET CAP
28	6121	HEAT EXCHANGER ASSY	86	4016	AIR PORT O RING
29	6122	GASKET (6)	87	4006	PIPE HOLDER
30	6123	EXHAUST DUCT	88	4008	HOSE BAND
31	6176	O-RING (P39)	89	4805	AIR OUTLET CAP
32	6124	WINDOW GASKET	90	6147	FLUE PIPE ASSY
33	6125	WINDOW FRAME GASKET	91	6148	SLEEVE FLANGE SET
34	6068	WINDOW PLATE	92	6149	UNDER COVER
35	6069	WINDOW GLASS	93	6210	LOUVER
36	6126	WINDOW BASE GASKET	94	6211	FRONT COVER
37	6127	COMBUSTION CHAMBER	95	6154	SWITCH ASSY
38	6181	COMBUSTION RING ASSY	96	6155	LAMP ASSY
39	6128	BURNER CAP	97	6156	TOP COVER
40	6129	BAFFLE ASSY	98	6212	LAMP PANEL
41	6130	CHAMBER GASKET	99	6158	FUEL TANK COVER
42	6131	CHAMBER CAP	100	6159	FUEL TANK ASSY
43	6132	POWER TRANSFORMER	101	6179	FUEL TANK CAP
44	6201	PWB ASSY	102	6165	FLOAT SWITCH
45	6134	PWB SPACER CLIP (A)	103	6178	FLOAT SWITCH PACKING
46	6135	PWB SPACER CLIP (B)	104	6177	OIL FILTER
47	6202	MICROPROCESSOR	105	6162	RESISTOR
48	6168	RELAY (A)	106	6213	CABINET ASSY
49	6169	RELAY (B)	107	6345	UNION NUT
50	6203	BUZZER	108	6194	WALL CLAMPS
51	6172	FUSE (250V 10A)	109	6214	BASE TRAY RETAINER
52	6173	FUSE (250V 2A)	110	6197	SCREW SET FOR FLUE PIPE
53	6170	CAPACITOR (1.5μFD)	111	6215	CARTON BOX
54	6187	TR ARRAY (M54563P)IC3	112	6175	CUSHION SET
55	6204	PHOTO COUPLER(IC9~11)	113	1148	OWNERS GUIDE
56	6137	CORD CONNERCTOR	114	8216	TOUCH-UP PAINT(WHITE)
57	6107	AIR LINE	115	8217	GLUE
58	6184	AIR PRESSURE SWITCH	116	8219	TOUCH-UP PAINT(GREY)